THIS PAPER IS PRINTED BY ELECTRICITY AT THE INTERNATIONAL ELECTRICAL EXHIBITION, PHILADELPHIA.

THE ELECTRICAL WORLD

VOL. IV.—No 11. NEW YORK, SEPTEMBER 13, 1884. $3.00 PER ANNUM. 10 CENTS A COPY.

The Latest Weston Incandescence Lamp.

We illustrate in this issue the incandescence lamp, made under Mr. Edward Weston's patents, and exhibited in great profusion at the Electrical Exhibition by the United States Electric Lighting Co.

The lamp, Fig. 1, has its filament made by carbonizing strips of Tamadine, cut and bent into the zig-zag shape shown. Tamadine is the name given by Mr. Weston to a material prepared by him from cellulose by a process not yet made public.

The carbonized filament is exceedingly strong and capable of sustaining very high temperatures for a long time.

The zig-zag shape tends to equalize the distribution of the light rays in all directions.

Fig. 2 shows the lamp placed within its socket, which contains the switch. The stem of the globe is inserted in the tube, shown over it, in Fig. 1, and cemented therein. This tube has two lugs on its periphery for the purpose of engaging with the groove provided to receive it in the upper part of the socket. Cuts are made in the edge of this groove to receive the lugs; and when the lamp is turned one-fourth around the lugs enter two depressions

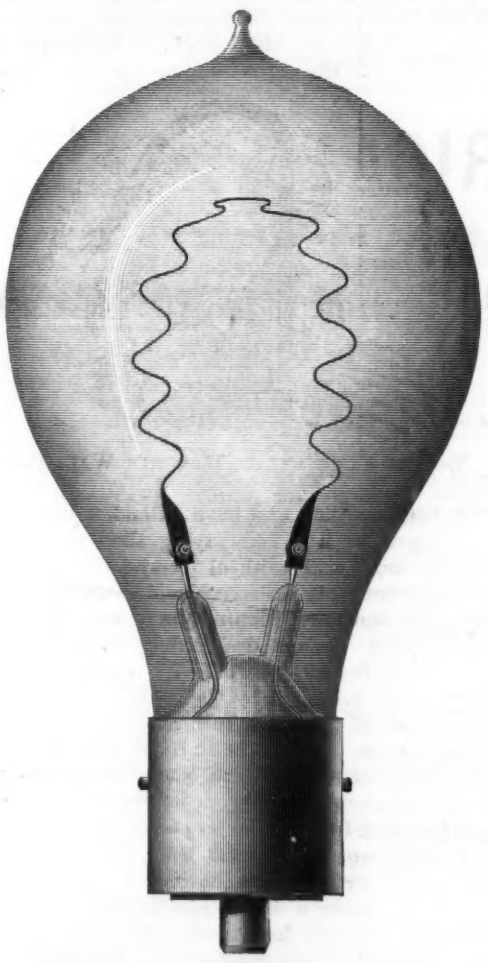


FIG. 1.—WESTON'S NEW LAMP.

in the upper edge of the groove and are thus secured from removal by jar or tremble.

The cross-section of the stem of the lamp in its mounting and placed in the socket, is shown by Fig. 3. This figure also shows the internal parts of the socket and switch.

The wires of the lamp connected with the extremities of the filament pass through the glass in the usual manner, and are connected at their other ends with the external contact pieces. These pieces consist of the bottom of the encasing tube and the central metallic stem shown at the bottom of Fig. 1 and in Fig. 3.

When the lamp is put into the socket these contact pieces press upon two volute springs which are connected each with one of the terminals of the line-circuit, but through the switch as to one terminal. This switch is a late improvement by Mr. Weston, and is shown in detail of working parts by Fig. 4. Description is hardly needed, the cut shows the thing so plainly. The current flows through one of the two L-shaped springs to the T-shaped lever and other spring, thence to the lamp. The T lever is pivoted at the rear and has a spring under it which causes it to lift speedily when pressure of the eccentric mounted on the key-shaft is removed. This eccentric has upon it two end depressions (plainly shown) which slightly engage a cross-bar on the lever when turned to circuit. But when the key is turned a little therefrom the lever is immediately snapped upward by the spring and free from the two contact springs. Thus the circuit is broken at two points simultaneously, with the effect of much decreasing the usual sparking.

Fig. 5 represents the wall-piece used for the purpose of effecting contacts for drop lamps. The plug and wall-piece shown have connections like those described as be-

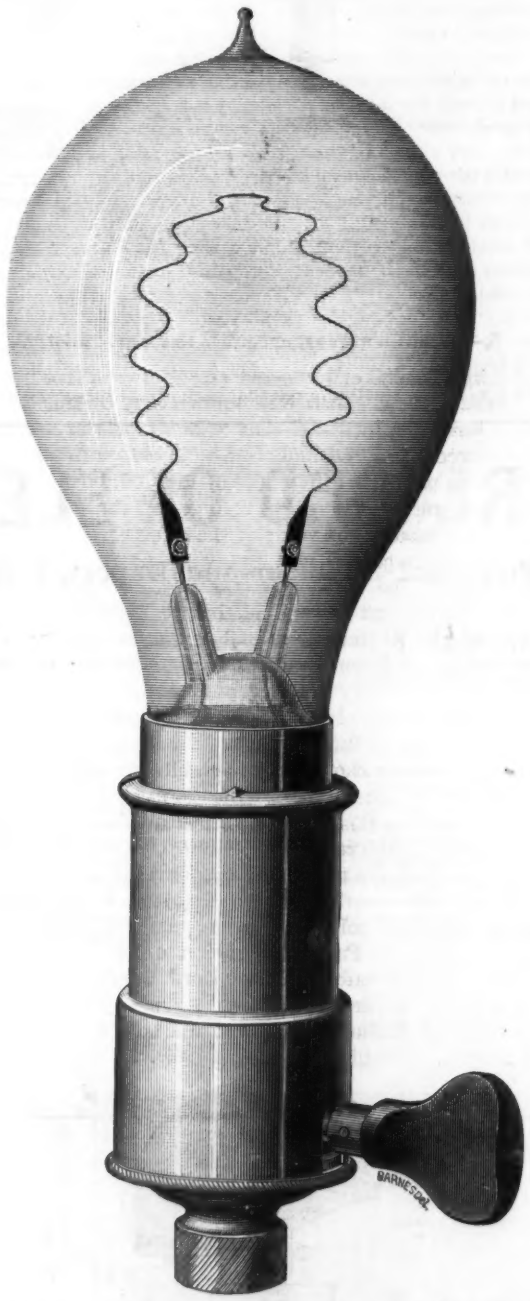


FIG. 2.—WESTON'S NEW LAMP AND SOCKET.

longing to the lamp and socket. In addition, this piece contains a safety plug in its bottom as shown by Fig. 6. The two trifurcated springs bear at their loose ends on the safety strip or plug. This plug may be removed or renewed through the cavity made in the wall-piece and covered by the strip shown in Fig. 5 in obvious manner. The whole arrangement is shown in section by Fig. 7.

Meeting of the Institute of Electrical Engineers.

A meeting of the American Institute of Electrical Engineers was held in the temporary headquarters of the Institute, in the Exhibition Building, Philadelphia, on the 10th inst., Mr. George A. Hamilton in the chair, the object being to arrange for a general meeting, the reading of papers, etc.

Dr. N. S. Keith, the Secretary, stated that there were about 40 members of the Institute constantly in attendance at the Exhibition, and that the number would be greatly increased next week, when the Telephone Convention was to be held—on the 16th; and the Railway Telegraph Superintendents would also be in session on the 17th. It was, therefore, thought that at least one good meeting could be held next week, to be followed by another. In reply to a question from the chairman, Dr. Keith stated that he had already two or three good papers ready for reading by members, and that in all more than half-a-dozen had been offered. They were all on great electrical questions of the day, and would probably lead in each case to animated and profitable discussion.

After a good deal of pleasant and informal chat, the meeting agreed to intrust to the secretary the duty of fixing a date for next week's meeting, and to make such other arrangements as might be desirable for the reading of papers.

On behalf of the meeting the chairman requested the secretary to place the rooms of the Institute at the disposal of other societies requiring temporary accommodation. It is thought that in this way the Institute of Electrical Engineers will show its appreciation of the generosity of the Franklin Institute in providing it with its commodious quarters during the Exhibition.

All members of the Institute of Electrical Engineers should make a point while at the Exhibition of visiting the rooms and registering. Letters can be written there, files consulted, interviews with friends had, advice and information obtained, and the general facilities of a regular headquarters enjoyed.

Exhibits at the International Electrical Exhibition.—I

We have already begun our series of illustrated and descriptive articles on the principal exhibits at the International Electrical Exhibition. It will be some time, how-

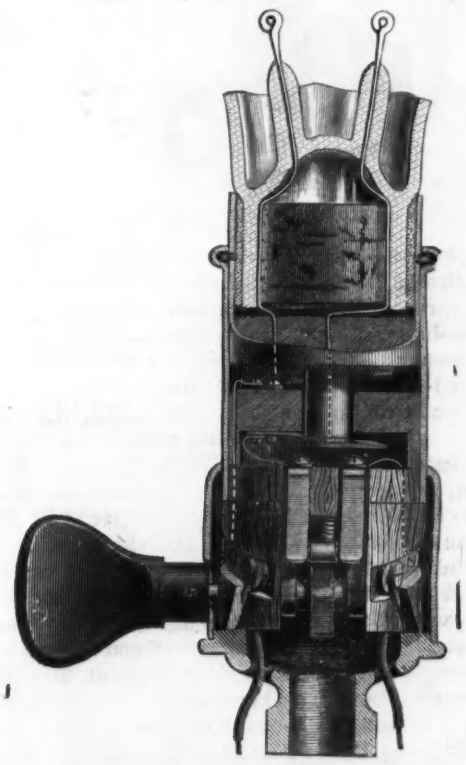


FIG. 3.—CROSS SECTION OF WESTON LAMP.

ever, before we can do justice to them all in the way of technical description, and meantime our readers, whether attending the Exhibition or not, wish to get a general idea as to what is to be seen in the various exhibits. We propose, therefore, to give week by week, beginning now, and ending as early as possible, a reviewing summary of all the displays worthy of notice. We shall not observe any special order of mention, as many of the exhibits are not yet ready, but wherever we can obtain the data it will be published immediately.

THE ELECTRICAL SUPPLY COMPANY.

The exhibit of this company is under the care of the electrician, Mr. Kelly, who has shown excellent taste and judgment in the arrangement. The finer and more delicate instruments are placed in cases around the sides of the spaces and in cases in the centre. The railing is formed in part of the company's own cables and those of the Callender Insulating and Waterproofing Co., insulated with bitite. The Electrical Supply Company show their own fine and magnet wires, office and annunciator wire, electric light leading wires, leaded wires and cables, diamond batteries, hard drawn copper wire and incandescent lamp fixtures. Numerous

samples can be inspected of the insulated wires and cables of the Clark Insulated Wire Company, the patent galvanized iron telegraph and telephone wire of Fred'k Smith & Co., Halifax, England, and of the materials used in building electric light towers, by the Star Iron Tower Co. A very fine collection is shown of the electrical test instruments, voltmeters, ammeters and motors of Messrs. Ayrton & Perry, of London. Elliott Bros., of London, have on view a number of their well-known galvanometers, rheostats, instruments of precision, and other apparatus; while Messrs. Woodhouse & Rawson claim attention for their admirable incandescent lamps, surgical lamps, fixtures, etc. The Wallace Diamond Carbons for arc light are shown in all diameters and lengths. The various devices of Mr. Killingworth Hedges, of London, may also be seen, such as switches for arc and incandescent lighting, safety plugs, self-acting plugs for replacing fused plugs; and Mr. Sidney E. Shelbourne's inventions are grouped together, including induction circuit cables, diagram indicators for connection of wires, new telegraph label numbers and insulating materials. Some notion of the importance of the exhibits may be formed when we state that the instruments on view last week, before the collection was complete, had a value of over $10,000.

TIME TELEGRAPH COMPANY OF NEW YORK.

This company exhibits a very handsome pavilion in Section I., No. 6—three electrical pendulum clocks or regulators, and a large number of secondary clocks, or dials, of beautiful and varied design. One of the regulators is fitted with a glass dial, which permits an easy inspection of the inclosed works; and it energizes all of the secondary clocks or dials, some of which are hung in different parts of the main building and the annex. A large dial is placed at each end of the main building, and one over the speaker's desk in the lecture room. All the above are giving actual 75th Meridian time correct to the second.

The three regulators are placed on the same pier, and thus a very remarkable phenomenon is presented, says Mr. Bailey, the electrician of the company supervising the exhibit. It has excited much interest among scientific men; not that it is new, but because it is seldom seen so admirably exhibited. It is that of the physical synchron-

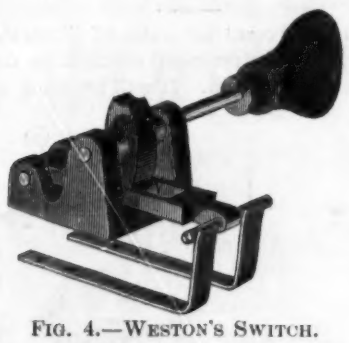


FIG. 4.—WESTON'S SWITCH.

ism of all three pendulums, caused by the vibrations being communicated from one to the other through the pier, and thus all three are swinging together in unison An electrical pendulum clock in the exhibit of the Rhode Island Telephone and Electric Co. (licensees of the Time Telegraph Company for this system) is synchronized electrically, and kept in beat with the master-clock above mentioned.

JAMES W. QUEEN & CO.

Great enterprise has been shown at the Exhibition by this firm, who may be looked upon as one of the standard scientific institutions of Philadelphia. Not alone do they make one of the finest exhibits, but they have been so wonderfully prompt and punctual as to have ready in the first week a 72-page catalogue of their exhibit, and to prepare a second edition enumerating and describing additions. Their exhibit is one of the international features of the Exhibition, seeing that it represents about fifty foreign manufacturers of electrical and other scientific apparatus, such as Carpentier, Edelmann, Gerard, Breguet, Hartmann, Duboscq, Elliott Bros., Ayrton & Perry, Verdin, and the Cambridge Scientific Co. The value of the instruments in the exhibit is placed at $25,000. We may perhaps call special attention to the separate exhibition by this firm of a fine collection of dynamo machines, chiefly those of Gerard and of Breguet. Among the instruments in the collection that attract general notice are the Ruhmkorff coils, one of which will give a spark of twenty inches. The special instruments made by Hartmann & Co., a firm enjoying the advice and suggestions of Dr. Kohlrausch, will also persuade the electrician to linger long at this exhibit. The apparatus made by the Cambridge Scientific Instrument Company, of England, is also highly interesting, as it includes apparatus of novel design and application in connection with the study of physiology. This part of the exhibit is worth alone about $1,200.

SYRACUSE, N. Y.—The Thomson-Houston electric lights in Syracuse have lately been increased to 200.

BALTIMORE & OHIO R. R. SHOPS.—The Thomson-Houston Electric Company have just shipped from Lynn, Mass., apparatus for 125 arc lights, to the Baltimore & Ohio R. R. shops at Mount Clare.

NEW LOCAL COMPANIES.—The following local companies have recently introduced the Thomson-Houston arc lights, viz.: The McKeesport Electric Light Co., McKeesport, Pa.; the Ashland Gas Light Co., Ashland, Pa., and the Germantown Electric Light Co., Germantown, Pa.

AMERICAN ASSOCIATION NOTES.*

Meeting of the Physical Section of the American Association for the Advancement of Science, Friday, Sept. 5, 1884.

1. On the Fritts selenium cells and batteries.

Mr. Fritts being absent, the secretary read a summary of the results which the inventor claimed could be obtained by the cells. Several members expressed a desire for more information on what, from Mr. Fritts' account, appeared to be an important modification of a selenium cell.

2. On the relation of the electro motive force of a Daniell cell, and the strength of the zinc sulphate solution, by H. S. Carhart.

This investigation was carried out in the physical laboratory of the University of Berlin in the spring of 1882 and was undertaken to ascertain whether the variation of the saturation in the zinc sulphate solution which surrounds

FIG. 5.—WESTON'S WALL-PIECE WITH SAFETY-STRIP.

the zinc in a Daniell cell affected the electro-motive force, and to what extent. It is well known that various investigators have obtained different values for the electromotive force of a Daniell cell. These different results are due partly to differences of method, but it is easy to convince oneself that slight changes of the sulphate of zinc solution modify the value of the electro motive force.

The method employed was the well-known method of Poggendorff. The resistance was measured in Siemens' unit, and the current determined by the deposition of silver, which was continued in each experiment for about ten minutes. The temperatures of the rheostat and cell were observed at every experiment and kept very nearly constant, the extreme limit of variation being 3.2° C. The method was entirely independent of the internal resistance of the cell and gave the minimum liability to polarization.

The results of these experiments were exhibited in columns representing (1) the degree of saturation of the sulphate of zinc, (2) the resistance employed, (3) the current, (4) the product of the resistance and current which represented the electro-motive force, and (5) this force reduced to volts. The final column was not made until after the recent report of the Paris Commission on the standard or legal ohm, and the publication of Lord Rayleigh's experiments with the silver voltameter.

The mean of all the values where zinc sulphate was used is 1.122 volts. The highest value is 1.142. If in a diagram

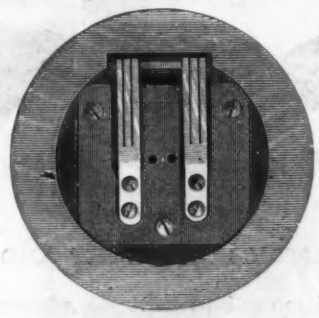


FIG. 6.—SAFETY-STRIP.

the ordinates represent the excess above the amount obtained with distilled water around the zinc plate, while the abscissas represent the percentage of the solution from 1 to 25, little variation occurs after reaching 10 per cent., while the maximum occurs somewhere about 5 per cent., while we can draw very nearly a plane curve through all the points. It thus appears that the variation in the saturation of the sulphate of zinc is sufficient to account for the larger part of the variation of different experimenters in measuring the electro motive force of a Daniell cell.

A Member: The care and trouble that has been expended on this determination has been very useful, but it seems after all, on general principles, that, inasmuch as the galvanic cell only acts in developing electro motive force by separation of the molecules into atoms, and that a certain amount of fluid is necessary for the action, it resolves itself into a question of how much water is present in the fluid.

[NOTE BY THE REPORTER.—Clerk Maxwell says, in speaking of the use of dilute sulphuric acid around the zinc (and the same remarks will apply to the use of pure water): "But besides the visible bubbles (arising from the electrolytic decomposition of the fluid) it is certain that there is a thin coating of hydrogen, probably not in a free state, adhering to the metal, and as we have seen that this coating is able to produce an electro-motive force in the reverse direction, it must necessarily diminish the electro motive force of the battery." Confirming these remarks is the table of Mr. Clark:

Daniell I. Amalgamated zinc, HSO_4 + 4aq, Cu SO_4 Copper = 1.079 volts.

Daniell II. Amalgamated zinc, HSO_4 + 12aq, Cu SO_4 Copper = 0.978 volt.]

3. Note on the periodic modification of electro-static induction, by Mr. Carhart.

In an experiment performed by the author, a thin disc of zinc perforated with 24 half-inch holes was mounted on a rotating apparatus between the positive electrode of a Holtz machine and an insulated brass ball. This brass ball was connected with one plate of a static telephone, the other plate of the telephone being connected with the ground. The Holtz machine was worked until a spark passed over to the brass ball and so charged the telephone. Then, on rotating the disc, a musical sound could be heard in the telephone with pitch depending upon the velocity of rotation as long as any appreciable charge remained upon the electrode. This electrode acts inductively upon the brass ball through one of the holes, the lines of force extending through the hole. But when the solid portion between the holes is present, induction is interrupted, at least in part. The turning of the disc, therefore, produces a periodic modification of the induction, and we will have the same between the two plates of the telephone.

* Abstracts of papers and discussions.

An Interior View of the Exhibition.

We have already published original views of the exterior of the International Exhibition seen by night and by day, and various plans of the interior. Now, through the courtesy of *Frank Leslie's Illustrated Newspaper*, we are enabled to reproduce on page 83 the very fine interior view given in its issue of this week. The sketch was taken by one of the staff artists on that journal,

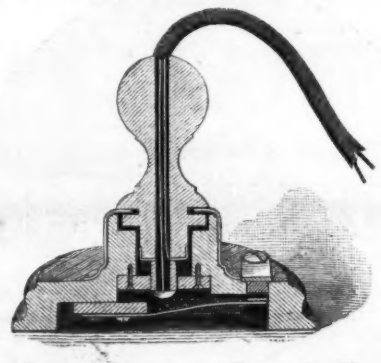


FIG. 7.—CROSS SECTION OF WESTON'S WALL-PIECE.

Mr. C. Upham, and all who have attended the Exhibition will agree with us in saying that it is an admirably vigorous and faithful representation of the scene. The fountain in the foreground is certainly one of the most prominent and picturesque features of the Exhibition building. It was designed by Prof. Marks and has already been described by us. We venture, however, to describe it again, as seen by the artist, in operation. It is in the centre of the main hall, and is surrounded by flowers and palms. It has a basin thirty feet in diameter, and a huge cone of stone in the centre twelve feet high, through which a large jet of water is thrown upward. At a height of twenty-five feet the jet passes through a double ring of incandescent lights, and then, striking a central ball, falls back over them in a shower. From the circular margin of the basin a dozen smaller jets are thrown up to mingle with the larger one, and three jets rise, unbroken, almost to the roof of the building. Over all are reflected constantly changing rays of colored light thrown from arc lamps. Looked at from the gallery, the appearance is that of a fiery fountain radiant with prismatic hues of wonderful brilliancy. We cannot but congratulate our contemporary on its enterprise in preparing so elaborate a view thus early, and its artist on executing his work so successfully. It may be mentioned that the exhibit in the foreground is part of that of the U. S. Government. Up in the gallery the Roosevelt organ, played by electricity, can be seen.

A TRIP OF INVESTIGATION.—Mr. Frank C. Mason, Superintendent of the Brooklyn Police Telegraph Department, has taken a trip to Chicago, with the object of investigating the police telegraph system in that city, and of applying any good points in it to his own work.

WESTERN UNION EARNINGS.—The earnings of the Western Union test offices, for the week ending Aug. 30, were $177,887, an increase of $8,298 over the corresponding week of last year. The stockholders at present number 4,250, against 2,700 for the same time in 1883.

RAILWAY TELEGRAPH SUPERINTENDENTS.—The Association of Railway Telegraph Superintendents will hold its annual meeting, according to announcement of Mr. P. W. Drew, Secretary, at the Colonnade Hotel, Philadelphia, on Wednesday, 17th inst., at 2 P. M. A full attendance of members and of those who propose to join the Association is desired.

THE INTERNATIONAL ELECTRICAL EXHIBITION, PHILADELPHIA—AN INTERIOR VIEW—MAIN FLOOR, INCLUDING THE FOUNTAIN. (See page 82.)

THE ELECTRICAL WORLD

PUBLISHED WEEKLY,

AT NO. 9 MURRAY STREET, NEW YORK.

W. J. JOHNSTON, Editor and Publisher.
N. S. KEITH, Associate Editor, Scientific Department.
T. C. MARTIN, " " News Department.
CLARENCE E. STUMP, Business Manager

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.00.

(Postage Prepaid in the U. S. or Canada.)

CLUBS.—In clubs of 4 or more, $2.50 a year each, with a free extra copy to the getter-up of a club of 8.
Subscription to foreign countries $4 a year.
In requesting your address changed, always give the **old** as well as the new address.

THE ELECTRICAL WORLD
HAS THE LARGEST CIRCULATION
OF ANY ELECTRICAL JOURNAL PUBLISHED, AND IS
THE BEST ADVERTISING MEDIUM.

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions.
Notices of Situations or Help Wanted, $1 to $3 an issue.

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News**, or information relating to any application of electricity, also marked copies of their local papers containing anything likely to interest electricians. **Anonymous communications** cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Matter for the **Editorial** Department should be addressed to
The Editor of The Electrical World, New York.
Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed simply,
THE ELECTRICAL WORLD,
NEW YORK.

NEW YORK, SEPT. 13, 1884.

A TRIAL TRIP.

From the beginning of the present month until the end of the year, THE ELECTRICAL WORLD will contain a large quantity of reading in regard to the great International Electrical Exhibition. It will give, as the present number indicates, elaborate illustrated descriptions of the exhibits, a full account of the proceedings, reports of the meetings of the various learned societies, important papers by distinguished scientists, and all the electrical news of the day. The numbers of the papers during that period will therefore be extremely valuable for present use and future reference. In order to afford all an opportunity of reading the paper, we will send it for the four months of September, October, November and December, to any address in the United States or Canada, postage prepaid, for one dollar, or to any foreign country for $1.25. Subscriptions for this excellent trial trip should be sent in at once. We trust that our friends will call attention to this advantageous offer, and that orders will be sent in without delay, as we cannot promise to furnish full files or back numbers later on.

A CANADIAN RENDEZVOUS.

When the proposition was first made that the British Association for the Advancement of Science should hold the meeting for 1884 at Montreal, it was thought by a great many persons, chiefly to be found on the other side of the Atlantic, that the experiment was hazardous, and more likely to be attended by failure than by success. The meeting has been held, and now every one is saying that a better choice of rendezvous could not have been made. We were never able to see any solid objections to Montreal. The city is as accessible to the majority of the British members of the Association as any of the ordinary resorts were at the time when the philosophers who established it adopted some of the practices of the old peripatetics. Then it is a healthy, picturesque, and romantic place, having withal an abundant store of material for the scientists of all tastes and leanings to study over and make papers out of for future sessions. It is, moreover, one of the most notable cities in that greater Britain which every year puts the mother country in a new perspective with regard to importance, duties, political relationships and social problems; and it contains many able representatives of modern culture and research. Indeed, we should have been greatly surprised had the meeting at Montreal been anything but a brilliant, a phenomenal success, in all respects. Prof. Bonney, the Secretary of the Association, speaking from memory, said he doubted whether the number of papers read fell short of the number presented at the great jubilee meeting at York; and while the papers had been above the average numerically, they had also been of unusual scientific value. The attendance had been proportionally large. We have endeavored to give our readers some idea of the electrical papers read in the various sections, and have had an *embarras de richesses* in them. If all the work in all the sections was as good as that within our province, and of which we have attempted to give a running sketch, with details here and there, the meeting of 1884 will be long remembered, not alone for its novelty of rendezvous, but for its great scientific results.

One remark or suggestion we would venture to make, however. Now that electricity occupies so much of the attention of the scientist and so large a space in the public mind, it would seem desirable that there should be a distinctive section or sub-section for it. Some of the electrical papers presented at Montreal were read before the mathematical and physical section, some before the subsection of physics, some before the mechanical section. Here are three sections, and others, such as the chemical and the geographical, might be added, before any of which electrical papers were read It does not appear to us unreasonable to think that if all the contributions on electrical theory and practice were laid before one comprehensive section, much running about from place to place would be avoided, and much time would be saved in the other sections for the reading of papers now crowded out. This respectful suggestion might find an application at Philadelphia during the sessions of the American Association.

The meeting of the American Association comes most appropriately close upon the meeting at Montreal, so that the scientific parliament may be said to adjourn at Montreal to resume at Philadelphia; and we believe that the opportunity of attending the sessions at the latter city has been one of the reasons why a majority of the members of the British Association crossed the Atlantic this year. Whatever the high purpose with which these scientific men, so many of whom are honored and esteemed among us, have visited this country, they are welcome, and we trust that great and lasting good will be derived from their sojourn here.

Electrical science was one of the main subjects of consideration at Montreal; it promises to be equally prominent at Philadelphia, where the Exhibition and the Electrical Conference lend it additional importance. It is natural that the eyes of all American electricians should be fixed on Philadelphia at this time and that so great a number of them should have assembled there.

TAKING THE CHANCES.

It is safe to say that there are very few professions in which the rank and file, as well as a goodly number of the more prominent members, so frequently "take the chances," as it is called, of finding themselves left out in the cold, as in the telegraphic profession, when they accept positions with opposition companies as they spring into their almost mushroom existence.

Of course we do not include in this category those officials whose services are necessary to get the new companies into operation, for they, as a rule, very wisely secure themselves by contracts, so that should the company sink or swim, they are not left in the lurch.

In point of fact, it is not much of a risk for this latter class, inasmuch as, generally speaking, they are not dependent upon a stated salary for their livelihood.

But it is to the batterymen, book-keepers, operators, managers and subordinate officials, to whom we more particularly refer.

It is true, also, that the first-class operator who has no aspirations in the matter of promotion, risks but little, and on the whole is just as likely to gain by accepting a position with an opposition company; but with the book-keepers and batterymen, whose work requires no special skill, it is a different affair, and it is surprising that so many of them are found willing to exchange a permanent position for one that may last one year or three months, and where the difference of salary may be only a few dollars per month.

It is likewise surprising, but not equally so, that in view of the many consolidations that have taken place within the past few years, so many chief operators, managers, superintendents, etc., have been found willing to give up positions and places in the line of promotion in their present situations, to assume an uncertain position, in many cases but little above the one they voluntarily resign. They do this notwithstanding the experience of many of their predecessors, and this, it would appear, they will continue to do to the end of the chapter, despite the fact that the oldest of the telegraph companies, in a pamphlet published to puff up the value of its shares in the eyes of capitalists, has most carefully pointed out that one of the causes which will prevent the organization of new and rival companies is the very fact that, owing to the well-known instability of opposition companies, a working staff would be unobtainable.

As the majority of the operators, managers, etc., are young men, it is very likely that their prime motives for "taking the chances" are a desire to gain prestige and experience, and there is no place like an opposition company to acquire the latter.

Said a junior official of one of the opposition companies recently, "I have learned more in the six months that I have been with this company than I could have learned in six years in my old position, and if I were aware that this company would collapse to-morrow, I would not have a tinge of regret for my action in giving up my former position."

Nevertheless, it is a critical time for a man who may have, by many years of assiduous study and attention to business, raised himself up several rungs in the ladder of promotion, when he receives an offer of a position with a new opposition company, even when the position will bring with it increased salary and higher rank. There are doubtless many such who prefer to retain their present salary and position than run the risk of losing both the new and the old positions.

In some cases the sequel may prove that they did right. It is just as likely, however, to show that they made a mistake.

It is so hard, after all, for a man to tell when his tide is at the flood.

We happen to know a man who recently received an offer of the superintendency of a certain concern at a salary double his present one. He had been in his present position for 25 years, but after much hesitancy he accepted the offer and entered upon his new duties and received the hearty congratulations of his friends.

The latter were somewhat astounded, a few days later, to learn that he had resigned his new position and had resumed his old duties at his old salary; having apparently come to the conclusion either that the new position was likely to prove unstable, or that he was unfitted to undertake the work.

We have since been informed that it was on the cards to have made him, within a very short time, consequent upon his success in the first position, general manager of the concern at four times his former salary; but he was not to know that, nor indeed did he give much opportunity to his new employers to inform him of it.

Two telegraph men, the younger of whom had lately resigned a position to take one somewhat better, and at a better salary, were recently conversing on this subject of taking the chances. The older gave it as his view that it was very well for young men to avail of these opportunities, but as for himself, he was too old. He had been with the same company and in the same rut for 30 years, and now he could not get out of it. True, he was a degree above the desk, and had a fair salary—a position and salary he was likely to retain as long as health remained to him. He could look around him, he said, and see men who began the business, and worked at the desk with him, now occupying prominent positions in the profession—some of them General Managers, others Superintendents, etc.

These men had, as a rule, struck out with new companies and had been successful. But, on the other hand, he continued, there were others who had also joined rival companies, and had held positions as managers, chief operators, etc., in those companies, but to-day he could point them out, working at a desk, whither they had fallen back and where they are likely to remain, worn out operators at a meagre salary; so that, he thought, he was, at least, better off than they.

And no doubt he was; but was he himself as well off as he might have been had he taken the chances in the early days of his career?

That is just the point where chance is taken, and it raises a question which every man has to decide for himself, when the opportunity for a prospective improvement in his condition arises, and in case of accepting the risk, whether he fails or succeeds may not entirely depend upon himself, because where there are so many contending for the few places in the higher circle, some will be disappointed, and when a man fails from this cause, it certainly is no disgrace; yet, upon himself and his own exertions much will depend.

At all events, should he fail, he may have the consolation of saying that he was not afraid to "take the chances." It is better "to have tried and lost than never to have tried at all."

The above considerations will apply, we think, to the whole round of practical work in electrical companies and industries.

TRAMPS OR SCIENTIFIC PILGRIMS?

It is very likely that the letter from Mr. Joseph Christie, published in THE ELECTRICAL WORLD, describing a visit to the grave of Franklin, may have induced a number of the visiting scientists in Philadelphia to follow our correspondent's example and pay their homage to the remains of the great philosopher. The old burying-ground where rests all that is mortal of Benjamin Franklin is walled in on every side, and it is safe to say that heretofore not one man in a month has intruded on its sleepy solitude; yet the Philadelphia *Evening Bulletin* of the 31st ult. contains the following, probably from some horrified old Quaker:

"The following letter was received by Mayor Smith this morning:

"'MAYOR SMITH:

"'Will you be kind enough to allow your officers to look at the graveyard at Fifth and Arch streets? It seems to be full of tramps, day and night. A FRIEND.'"

Can these be the visitors, or are they native Philadelphia scientists? The *Bulletin* adds that the "lieutenant of the district says he never saw or heard of a tramp in Christ Church burying ground."

The British Association Meeting at Montreal.—III.

Our report of the proceedings of the British Association at Montreal was brought down to the 2d inst. in our last issue, but of course many of the papers were referred to but briefly. We now continue the summary of papers read and of discussions upon them.

In the mathematical and physical section, after the reading of Prof. Lodge's paper on the seat of the electromotive forces in the voltaic cell, and the discussion upon it—already reported in these columns—Prof. Hele Shaw read a profound paper on a new theory and method of indicating and recording velocity. He has endeavored to solve the problem of devising an instrument, communicated with by a series of intermittent effects, but which should indicate continuously the velocity of the moving body. The apparatus is generally applicable.

Sir William Thomson followed with remarks on the subject of "Safety fuses for electric circuits." He considered these fuses highly necessary, but objected to the use of lead and other soft metals. He preferred a short length of fine copper wire, about ¾-inch long. After a lively discussion on the subject, Lord Rayleigh won a hearty support to a vote of thanks to Sir William for his experiments and investigations.

Lord Rayleigh then read a carefully prepared mathematical paper on the difficulty of using a submarine cable for telephonic purposes.

Mr. W. H. Preece remarked that the question was one of great interest, and gave his experience in telephoning through the Dublin and Holyhead cable—60 miles—which had been fairly successful. Accurately heard conversation could not well be maintained beyond some twenty-five miles. Other experiments had proved that it was at present impracticable to use underground wires in cities for distances of more than some twelve miles. In every experiment telephonic circuits were made metallic. With an arrangement of double wires he said that he had no difficulty in speaking through 240 miles of overground wires.

Prof. Alexander Graham Bell considered the subject of considerable interest and said that he was much interested in the discussion.

Mr. W. H. Preece said that by using an artificial resistance of two or three thousand miles he could not speak at all through a cable.

Dr. Traill, of Dublin, suggested the continuation of experiments in the direction indicated and the resuming of the discussion next year.

Lord Rayleigh next gave "A Lecture Experiment on Induction," which was listened to with considerable interest by those present. The noble lord also explained the formation of "a galvanometer with twenty wires."

Professor Schuster followed with a dissertation on "The Influence of Magnetism on the Discharge of Electricity through Gases."

In the section of chemistry in continuation of a former paper on discharge of electrical accumulators by Professor Frankland, the author communicated the results of a study of the phenomena attending the discharge of accumulator cells, containing alternate plates of plumbic peroxide and spongy lead. In all the experiments moderate currents only were drawn from the cells, such as would be used for the supply of 14 or 15 Swan lamps of 20 candle-power, but very much heavier currents can be obtained if desired, even up to 250 ampères. From the results of his experiments he draws the following conclusions: 1. The energy of a charged storage cell is delivered in two separate portions, one having an electromotive force of two volts and upwards, the other an electromotive force of five volts and under. One of these may be termed useful and the other useless electricity. 2. The useful electricity is greatest when the discharge is intermittent, and least when continuous. 3. Neither in the intermittent nor in the continuous discharge at high electromotive force is the current, through uniform resistance, augmented by rest. 4. The suddenness of fall in potential indicates two entirely distinct chemical changes, the one resulting in an electromotive force of about 2.5 volts, the other in one of about 0.3 volt. 5. The chemical change producing low electromotive force is the first to occur in charging, and the last to take place in discharging the cell. It is the change which occurs during what is called the "formation" of a cell, and for economy's sake a reversal of this change should never be allowed to take place. 6. It would be difficult to suggest an explanation of the nature of these two chemical changes. 7. Currents of enormous strength can be obtained from storage batteries coupled in parallel. For instance, a current of 25,000 ampères is practicable from 100 cells. Such a current reduces to insignificance the output of the largest dynamo ever built.

On Monday, 1st, in the section of mathematics and physics, Prof. Schuster opened the discussion, which has already been published in our report, on the meaning of sun spots. Following that, Prof. Balfour Stewart and W. Lant Carpenter submitted a paper "On Certain Short Periods Common to Solar and Terrestrial Phenomena." Mr. W. Lant Carpenter said the coincidence of maxima and minima of magnetic disturbances, auroral displays, average rainfall, etc., with sun spots, in a period of 11 1-10 years, had long been observed, and was admitted generally. The influence on terrestrial phenomena was very great, and the object was at present to discover if there was any close connection between the two sets of phenomena. Elaborate methods of analysis had been applied to the daily temperature ranges at Toronto and Kew and the daily sun spot inequalities by Professor Stewart and the lecturer, who stated that they were also comparing the ranges in magnetic declination for the same period. They found by results that there were short periodical fluctuations in the sun's spot areas, grouped round periods of twenty-four and twenty-six days, and there were also corresponding oscillations in the Kew temperature ranges. The magnetic and temperature alterations followed the solar changes very rapidly, magnetic changes taking about 1.6 day to travel to Europe, the temperature changes taking eight days, hence the Kew weather followed the Kew magnetic weather at an interval of from six to seven days. Rev. Father Perry considered it to be an established fact that there existed a decided connection between solar and magnetic phenomena.

In the section of mechanical science, Sir James Douglas, engineer to the Trinity House of England, read a paper on improvement in coast signals. He referred to the old system of signaling, and remarked that it was now found to be possible at any coast signal station to render trustworthy service by those agents in all the varying conditions of the atmosphere,—first, in providing a reliable and efficient signal; and, second, in giving it such a clearly distinctive character as to enable the mariner to determine accurately his geographical position. He proceeded to give the various intensities of the various lights, and said the electric light, with an intensity of 60,000 candle units, was now found to be practical and reliable for coast lighting, and was found to outstrip all competitors. With regard to economy, mineral oil had the advantage of all its rivals up to the maximum intensity at which these luminaries are practicable. An exhaustive series of experiments had been carried out at Trinity House, with mineral oil, coal gas and the electric arc, but the results had not yet come to hand. On the coast of England they were converting as rapidly as possible all fixed lights to occulting ones. Sir James illustrated his paper by numerous and elaborate diagrams, and was frequently applauded during its delivery.

Mr. W. H. Preece, chief electrician to the English post-office, followed with a paper on "Secondary Batteries." About the middle of last year a series of experiments was commenced with secondary batteries on some of the telegraphic circuits terminating at the General Post-Office, London, and their satisfactory results during twelve months' trial led him to bring the subject of their results before the section.

Mr. Preece then read a second paper, the subject being "Domestic Electric Lighting." We gave a brief notice of this last week. He was astonished that there were no private houses lit by electricity in Canada, but they might depend the time would come when it would be brought to their doors like water and gas. He was lighting his house in England with gas, but he burned the gas in his garden,—that is, he allowed the light to come into his house and he kept the poison outside. The *modus operandi* was, he had a two horse-power gas engine in the garden which worked a dynamo, which generated the electric currents. The gardener lit the engine in the morning, which worked all day, and the dynamo was made to charge some secondary batteries, where a supply of electricity was stored up during the day for use at night. He used the old form of batteries, viz., lead plates and sulphuric acid, and he could assure them that he got the greatest satisfaction from them and the air was not vitiated. As regards economy, while he had done all he could as regards efficiency, his experiment was no criterion.

Prof. Sir William Thomson strongly advocated the use of electricity for private house lighting, and gave as an instance the house of Sir William Armstrong, at Craigside, near Newcastle-on-Tyne, where the power is obtained by a turbine placed in a waterfall a mile and a half from the dwelling-house. He was astonished at having seen no incandescent lamp in Canada. With their splendid waterfalls and water-power electricity must give the light of the future in the Dominion.

Dr. Anthony Traill, LL. D., F. T. C. D., Chairman of the Portrush Electric Railway, contributed a paper on that construction. The Giant's Causeway and Portrush Tramway was specially constructed with a view to the application of electricity as a motive power. The chief distinctive features by which it differs from tramways, as usually constructed, are: 1st. The gauge, which is three feet; 2d. The position of the tramway in respect to the side of the road, viz., its being placed alongside of the road, and not in a central position, and being raised slightly above the surface of the road; 3d. The form of the rail, a flange being substituted for a grooved rail; 4th. The motive power, the application of electricity as the chief motive power for propelling the tram-car; and 5th. The use of water-power as the actual source from which the motive power is derived. The tramway was a continuous series of long inclines. Gradients one in forty-five and one in forty are frequent for upward of a mile in length, while steeper gradients of one in thirty exist for shorter distances, the worst gradient being one in twenty-five, the total rise from the depot at Portrush to the summit being 208 feet. The system finally adopted of utilizing electricity as the motive power differs from the system used on the Lichterfelde, the Charlottenburg and the Paris electric tramways, where overhead electric conductors and storage batteries were used. On the Giant's Causeway Electric Tramway, the track being laid along the side of the road, a third rail or rigid electric conductor was placed along the toe of the fence or ball, consisting of from twenty to thirty foot lengths of T irons, weighing nineteen pounds to the yard, supported on short wooden posts with insulating caps of "insulite," the top surface of the conducting rail being three inches wide and eighteen inches above the level of the tramway rails. The electricity is now generated by water power on the River Bush, situated at a distance of 1,600 yards from the nearest point of the tramway, and five and a half miles from Portrush. A fall of twenty-six feet head of water is used to drive two of Alcott's turbines, each capable of working up to fifty-two horse-power. These drive on a single shaft, which communicates by belting with a generating Siemens dynamo. Each electric car is fitted with a starting handle at each end, and with powerful brakes, and is capable of drawing a second car behind it, with a total complement of 44 passengers comfortably seated. A large-sized working model and diagrams, illustrating the turbines and other details, were exhibited. The daily running of the electrical cars commenced on Nov. 5, 1883, from which date till July, 1884, upward of 13,000 electrical train miles had been run. The working expenses of the electrical train mile are five cents a mile as compared to eleven and twelve cents per steam engine train mile, and the average cost of twenty cents to twenty-four cents per mile, when horse power is used.

Papers on "Electrical Tramways," by Mr. Holroyd Smith, and "A New Volt-meter," by Capt. Carden, were taken as read.

On Tuesday, 2d inst., in the sub-section of physics, Lord Rayleigh read a paper on Clark's standard cells, and Prof. Fitzgerald one on the analogy between electricity and heat, while Mr. J. U. Mackenzie drew attention to the features of merit in the telemeter system. The next paper was by Professors Reinhold and Rucker on the "Thinning of Liquid Films by Electric Currents," and was read by Professor Reinhold. The main point brought out was that a film on such liquids as liquid glycerine and soap solution was gradually turned black, becoming about half its former thickness when an electrical current was passed through it, and then, when the current was stopped, changed suddenly back to its original color. Considerable discussion ensued on the subject.

Mr. W. H. Preece read a paper "On the Law Regulating the Connection between Current and Intensity of Incandescence of Carbon Filaments in a Glow Lamp." He said that in 1883 he had pointed out that from experimental data the light emitted from a glow lamp varied apparently at the sixth power of the current. He had verified this law by experiments which had been satisfactory. Prof. Kittler, of Darmstadt, and Capt. Abney had made—independent of each other—most careful and exhaustive measurements in the direction indicated. Experiments confirmed the law that within certain limits was embraced the ordinary range of a glow lamp when used for artificial illumination. As long as the resistance and the current varied uniformly the law held good. He pointed out the place where disintegration probably set in, and suggested that the exact point should be determined.

Prof. S. P. Thompson next dealt with "The Equations of Dynamo-electric Machines," and a paper by Mr. E. O. Walker on earth currents was taken as read.

In the section of mechanical science, Prof. George Forbes, M. A., F. R. S. E., read a paper on "The Heating of Conductors by Electric Currents." The heating of conductors by the passage of an electric current is, he pointed out, injurious to the insulation, if the conductor be insulated, and may lead to risks from fire. In small installations the heating of conductors is always small because of this fact, that if contractors were to lay down wire so that overheating ensued then we may be sure that the resistance would be far too great for the capabilities of the dynamo machine. But in large installations, much greater currents being carried, the heating may be very great although the resistance of the circuit is small, and it becomes a matter of the utmost importance to know how the heating depends upon the size of conductors and the current's density. After detailing a number of experiments, Prof. Forbes said that one of the most important results he had obtained was that the insulation of an aerial conductor was favorable and gave a power of using larger currents with conductors of the same size when the diameters are not very great. In small installations the question of safety from fire or injury to insulation was not likely to crop up, but the tables which he had calculated would be useful in calculations on the amount of heating.

Prof. S. P. Thompson next came forward with a paper on "Some Points in Dynamo-Electrical Machines." The paper was entirely technical.

A very interesting meeting was that held on Tuesday morning in the geographical section, when a paper was presented by Lieut. Ray on "Arctic Experiences at Point Barrow," and was followed by Lieut. Greely on "Recent Discoveries in Northern Greenland and in Grinnell Land." Lieut. Greely was warmly received and a good discussion followed the reading of his paper, the electrical and magnetic data of which we have already given.

National Conference of Electricians.

The lecture room of the International Electrical Exhibition was well filled at 3 P. M. on the 8th inst., the day and hour fixed for the opening of the National Conference of Electricians, held under a recent Act of Congress. The early proceedings and arrangements in connection with this Conference have already been fully detailed in THE ELECTRICAL WORLD.

The body of the lecture room was occupied by ladies and gentlemen, attracted by the fame of the scientists announced to take part in the preliminary exercises. The Electrical Commission was represented by its President, Prof. Henry A. Rowland, and Sir Wm. Thomson, Vice President; Prof. M. B. Snyder, Recording Secretary; Prof. Simon Newcomb, Dr. W. H. Wahl, Prof. E. J. Houston; and the electricians who signed the official register were: L. Duncan, Sylvanus P. Thompson, J. W. Moore, A. L. Kimball, Elihu Thomson, A. W. Reinold, E W. Rice, Jr., J. H. Cotterill, W. H. Preece, Conrad W. Cooke, H. S. Carhart, Thos. D. Lockwood, O. E. Michaelis, Theo. F. Jewell, W. T. Sampson, M. W. Harrington, E. W. Blake, Jr., Wm. A. Anthony, A. E. Outerbridge, E H. Hall, S. H. Short, B. A. Fiske, C. Carpmael, A. E. Dolbear, J. Hamblet, N. S. Keith, C. H. Clarke, Spencer Borden, J. B. De Motte, F. J. Sprague, W. P. Trowbridge, Chas. B. Dudley, T. C. Mendenhall, Chas. K. Wead, D. Draper, Thos. French, Jr., W. L. Hooper, Wm A. Rogers, E. A. Scott, F. E. Nipher, C. F. Himes, Oliver J. Lodge, Geo. Forbes, Wm. Harkness, W. H. Spangler, A. Graham Bell, N. D. C. Hodges, Brown Ayres, E. L. Nichols, S. P. Langley, J. G. MacGregor, W. F. Barrett, G. E. Dasselli, C. H. Koyl, J. B. Murdock, S. M. Plush, G. A. Hamilton, H. T. Eddy.

Prof. Simon Newcomb: The U. S. Electrical Commission has charged me with the honorable duty of calling this conference to order and making a brief statement of its objects. It was hardly necessary to qualify this statement by the word "brief," from the very necessity of the case. It was only a short time ago—this forenoon—that I was informed of this duty. I have, therefore, had no time to prepare any remarks whatever, and will merely do what is required of me—state how it is that we come to be called together.

The enormous advance made in electricity within the past few years has resulted, as you know, in several electrical exhibitions in other countries. The object of these exhibitions is to bring together the various improvements which are made by inventors in the applications of electricity. The possibility of these improvements, I may say, parenthetically, offers a very remarkable example of the practical value of pure mathematics. It is only in consequence of the reduction of electrical phenomena to mathematical laws, and their expression in such technicalities as ohms, volts and ampères, that it has been possible to make the great improvements with which you are so familiar in the practical applications of electricity.

The foreign exhibitions to which I have referred have generally had invited to them conferees, both from their own and from other countries, with the object of exchanging views. When this exhibition was proposed by the Franklin Institute it seemed eminently proper that the same course should be taken, that advantage should be taken of this opportunity to bring together, both from our own and from foreign countries, such experts in the science of electricity as could enlighten us on the subject of its practical application. You are brought here together as practical electricians interested in the improvements made on this subject, and each of you desirous to learn from others. That you might so learn, however, it was necessary to have a programme of operations; and that programme has been made out in some sort under the auspices of the United States. The Franklin Institute, desiring that the electricians of the country might take advantage as far as possible, and avail themselves of the opportunity thus afforded, made an application to Congress, at its last session, for assistance in the present Conference; and although in the law passed no special reference is made to the Franklin Institute Exhibition, yet we are here on the grounds of the Institute, and in some sort as their guests, and they have courteously offered to us all the facilities at their command.

We are therefore here, I say, as practical electricians, desirous to learn from each other, and exchange views on the list of subjects which has been made out by the United States Commission, with the best light it could get from the practical men with whom it consulted. We hope to have your views on all these points, and to have your support in any public measures you may deem advantageous to present to the government, with the view of getting support for them in the future.

With this statement of the objects of the present commission, gentlemen, I have the honor to introduce to you the President of the Commission, who has also been nominated President of the Conference, Professor Henry A. Rowland, of Johns Hopkins University, Baltimore. (Applause).

ADDRESS OF PROFESSOR ROWLAND.

To the student of science who has a disposition to look into the pages of history, no life has greater interest than that of Archimedes, and yet there are few men about whom so little is known. Living more than 2,000 years ago, the accounts of him which have come to us are little short of fabulous, and yet they are of such a nature that we can say without any doubt that he was a genius such as the world has seldom seen. To him we owe some of the fundamental facts of mechanics, such as the principle of the lever and the pulley, and the fact that a body immersed in a liquid loses in weight as much as an equal volume of liquid weighs. And in military engineering his success was so great that he prolonged the siege of Syracuse by the Romans from what would probably have been a few days to three years. His engines shot against the enemy immense numbers of darts and huge stones, which mowed them down in columns, and falling on their ships destroyed them. He thrust out huge beams from the walls over the ships and drew them into the air, where they swung to and fro to the amazement and terror of the Romans and were finally dropped and sunk to the bottom of the sea. He is even said to have set them on fire by means of the reflected light of the sun. But his principal work was in geometry, and of this I only need to quote the words of Prof. De Morgan referring to those geometrical works of Archimedes which have come down to us. "Here," says Prof. De Morgan, "he finds all that relates to the surface and solidity of the sphere, cone and cylinder and their segment. A modern work on the differential calculus would not give more results than are found here." As to the quality of the individual, the impression which his writings give us is that of a power which has never been surpassed. No one has a right to say that Newton himself, in the place of Archimedes, could have done more.

Thus before the birth of modern science, in the dim ages of the past when the ligh of history begins to fade and the mist of legend to cover our view, there lived a man of almost superhuman intellect whose mind seemed equally adapted to either pure or applied science. And yet Plutarch says of him. "Archimedes possessed so high a spirit, so profound a soul, and such treasures of scientific knowledge, that, though the inventions (referring to his military engines) had now obtained for him the renown of more than human sagacity, he yet would not deign to leave behind him any commentary or writing on such subjects; but, repudiating as sordid and ignoble the whole trade of engineering, and every sort of art that lends itself to mere use and profit, he placed his whole affection and ambition in those purer speculations where there can be no reference to the vulgar needs of life; studies, the superiority of which to all others is unquestioned, and in which the only doubt can be, whether the beauty and grandeur of the subjects examined, or the precision and cogency of the methods and the means of proof, most deserve our admiration."

Here then, at the dawn of science, the question of the relative value of pure and applied science had been brought up. To the people of Syracuse, who had to defend themselves against an overwhelming enemy, the military engines of Archimedes were of far more interest than the whole of geometry, for the knowledge of the ratio of the solid contents of a sphere and its circumscribed cylinder cannot bring a dead man to life or restore wealth to a plundered city. And yet, from a point of view distant more than 2,000 years, we are forced to admit that Archimedes was right. Archimedes' engines of destruction have passed away, but the geometrical and mechanical truths which he discovered are to-day almost the axioms of the mathematician and the worker in physical science, and the ratio of the circumference of a circle to its radius is to-day the most important of our physical constants.

But this is only a meagre part of the influence of this man. The truths which he discovered have formed a part of the education of every student of mathematics to the present time, and have given pure intellectual enjoyment to all. They have helped to form the minds of all those whom we consider great in our science, and they have done their share in that march of progress which is gradually transforming the world.

Great should be the honor in which we hold the intellect of Archimedes, but greater should be our reverence when we approach that noble spirit which could ignore all worldly considerations and prefer the truths of geometry to the vast physical power given him by his other inventions, which were his amusements for a moment. We now see that he was right, but we cannot for a moment suppose that he foresaw, except dimly, any so-called practical advantages from his discoveries. A thousand times no! He preferred his geometrical labors because of a subtle quality of his mind, an instinct toward that which was highest and noblest and a faith that the pursuit of what is noble is the surest road to the final happiness of the individual and of the world. Our highest moral qualities are of this nature, and we despise as the lowest of the low one who is honest because "honesty is the best policy," but esteem him whose instincts lead him to honesty whatever the consequences.

So we reverence the noble and lofty spirit of Archimedes, and yet we do not at the present day quite agree with his estimate of the relative value of his works. His military inventions were far from worthy of being despised, even though the only reason were that they gave the world three more years of Archimedes' life. The world is not formed of disembodied spirits, but of men, in whom there is a wonderful combination of mind and matter, and a sound mind in a sound body is the highest type of manhood. But we also know that the mind is hampered by many considerations connected with the body. Archimedes recognized this, and his noble spirit revolted at it. But to-day we see that no progress can come from this method of treatment: the body still remains, however much we may despise it, and the buzzing of a fly can disturb the most profound thought of the philosopher.

We now study the laws of nature and seek thus to assist our bodies in obeying the thoughts of our minds. Our railroads carry us hither and thither on the earth with somewhat the facility of spirits, and our thoughts pass with almost the speed of light to the uttermost portion of the earth. The steam engine does our work, and labor-saving machinery takes the place of our hands. With a minimum amount of labor we can to-day possess luxuries unknown even to kings in ancient times, and our minds are free to study the order of nature or engage in any intellectual pursuit we may desire. Instead of being the slaves of nature and groveling in the dust before her to find the food which we crave, we have now assumed the command, and find her a willing servant to those who know her language.

But here we reach the keystone of the problem. To command her we must know her language. Knowledge, then, is the price of her service, and she obeys not the ignorant or degraded, but grinds them into dust beneath her heel.

Knowledge, then, is power, and it is more than power; it is that which the intellect most craves and is the object of many of our highest aspirations. What is the truth, is the goal of intellectual mankind in all ages, and its pursuit leads not only to intellectual but also to physical satisfaction.

The pursuit of the one leads to the other, and we shall see as we proceed that the only way for the world to progress in practical science is by the cultivation of the theoretical science.

Pure science must exist before its applications, and the truths of pure science are far more reaching in their effects than any of its applications; and yet the applications of science often have a much more immediate interest for the world at large than many discoveries in pure science, which will finally revolutionize it, both physically and mentally. They both have their importance and both are at work in causing that intellectual and material progress in which the world is now pushing forward with giant steps. But there is this difference—the names of the great inventors are seen in every paper and their deeds are recounted to the rising youth of the country as examples to be followed. And yet the discoverers of the principles on which their inventions are based may have died in comparative obscurity, with poverty knocking at the door. We are in no danger of forgetting those who have been successful in those applications of science which are in daily use, and it is useless to repeat the story of the telegraph or telephone, but it will be of more interest for me to recall to your minds a few of the landmarks in our science and then to consider the present state of our science, with a possible glance into the future.

Thus we shall obtain a clearer view of how our science has been built up and of the means which are necessary for its further progress. We shall also see the relation between pure and applied science, and the relative importance of the two in the progress of the world.

It is impossible for one here to discuss the reasons why the ancients followed their science to so short a distance and the world had to wait more than two thousand years before the light of modern science commenced to shine. It must be left to the psychologists and historians. But this I may say, modern progress is cumulative. By the study of the science of the past, the minds of men are trained for its further advance in the future, and so when there was no science to study there could be but little training of the mind in the true methods of thought.

The average intellect of mankind has improved, and what could only have been comprehended in past times by a few is to-day understood by the majority of educated persons. And this increase has been most apparent in the reason and moral sense of mankind, the two qualities of the mind which come most into play in the study of science. To the mind of the ancients, where the imagination ran riot without the guide of reason or a warning from their moral sense to speak the truth, it was easier to attribute the attraction of rubbed amber to an inherent soul or essence, which, awakened by friction, went forth and brought back the small particles floating around, than to examine and find out the truth.

The simple experiment of the amber remained without investigation for 2,200 years. Had the reasoning of many modern persons been followed, we should never have had a science of electricity. Why should anybody investigate this phenomenon, this feeble force, which could only attract a few particles of dust? The world could eat, drink and take its ease without doing anything in the matter, and it did so for more than 2,000 years of intellectual, moral and physical degradation. Then the awakening came, and men began to feel that they were reasoning beings. They began to see that there were other pleasures in the world besides animal pleasures, and that they had been placed in this wonderful universe that they might exalt their intelligence by its proper study. No question of gain entered into the minds of these early investigators, but they were led by that instinct toward truth which indicates the highest type of man. And yet their researches have transformed the world, not only intellectually, but physically. Some would say that science had been degraded by its applications, but who, that looks over the world at the present time, can think so? There is no danger of this view becoming general; the danger is in the other direction, and that science shall be degraded in the estimate of the world by the idea that its principal use is to be applied to the common purposes of life. A thousand times no! Its use is in the intellectual training of mankind and the high and noble pleasure it gives to those who are born to understand it; to lift mankind above the level of the brute and to make him appreciate the beauties and wonders of nature; to cause him to stand in humiliation and awe before that universe which the intellect of ages has attempted to understand and yet has failed; to make even Newton say: "I know not what the world may think of my labors, but to myself it seems to me that I have been but as a child playing on the sea-shore; now finding some pebble rather more polished, and now some shell rather more agreeably variegated than another, while the immense ocean of truth extended itself unexplored before me."

But the great moral law of the universe here enters. If the world would only pursue those things which are high and right and noble its reward would not be confined to the minds of men. Physical rewards await it as well, and disease, that principal cause of human misery, would almost pass away when the effect of inheritance from the present generation had passed. So the pursuit of pure science brings not only the rewards I have mentioned but the physical rewards of applied science and the pursuit of applied science gives wealth which may be again employed to further pure science. So the two react on each other to produce that perfect whole, modern science, pure and applied.

This moral law of the universe is well illustrated by the well-known story of Solomon.

"The Lord appeared to Solomon in a dream by night: and God said, ask what I shall give thee.

"And Solomon said: 'Thou hast made thy servant king instead of David my father; and I am but a little child; I know not how to go out or come in.'

"'Give, therefore, thy servant an understanding heart to judge thy people, that I may discern between good and bad; for who is able to judge this so great people?'

"And God said unto him, because thou hast asked this thing, and hast not asked for thyself long life; neither hast asked riches for thyself, nor hast asked the life of thy enemies; but hast asked for thyself understanding to discern judgment. Behold, I have done according to the word; lo, I have given thee a wise and an understanding heart; so that there was none like thee, neither after thee shall any arise like unto thee.

"And I have also given thee that which thou hast not asked, both riches and honor; so that there shall not be any among the kings like unto thee all thy days."

So the world, when it chose knowledge and truth above all things, acquired not only the treasures of pure theoretical science but also the wealth and riches and honor which come from applied science such as the world has never seen before and could see in no other way.

It is to William Gilbert, an English physician, that we owe the commencement of the modern science of electricity. His book on the magnet was published in 1600 and contained his electrical experiments. Thus, at this early date the similarity of electrical to magnetic attraction was recognized. But how slowly did the subject advance! The difference between conductors and non-conductors was discovered by Grey. But not until 1746, 150 years after Gilbert, was the Leyden jar invented. Then the remarkable nature of the phenomenon became apparent, and the world was startled by it. The subtle spirit which went forth from the amber, which was so feeble as only to attract dust, now flashed forth with light and sound and heat, and could cause the strength of the giant to vanish. To the world at large, there was now something worth looking into. But do we think that the spark from the Leyden jar is more wonderful than the gentle attraction of the amber? By no means, for, to the scientist, they are both equally remarkable and beyond our powers of explanation. It is only to the vulgar and uneducated taste that the tinsel and gew-gaws of an electric spark appeal more strongly than the subtle spirit of the amber. Nevertheless, despicable as the means, the spark of the Leyden jar acted as a trumpet-call to Europe and even America to come to the study of the wonderful science of electricity. At no other time has there been such excitement over any electrical discovery, and electrical experiments became general.

It was only after the discovery of the Leyden jar that the idea of an electric current occurred to mankind, and this current was even transmitted to a distance by a wire and a shock given to a person across the Thames, the water forming the return circuit. And the English experimenters even went so far as to form a circuit with the two observers two miles apart, using the earth as the return circuit. Thus the fundamental fact which forms the basis of the telegraph was early observed.

But isolated facts are of little value unless connected together by something which we call a theory, and in this line we owe much to Franklin, whose letters on this subject appeared between 1747 and 1754. To him we owe the theory of positive and negative electricity, and the fact that they are always generated in equal amounts, a law whose importance can scarcely be estimated. He investigated the Leyden jar and showed that the coatings had equal positive and negative charges and explained the fact that the jar cannot be charged when the outside coating is insulated. He invented the charge and discharge by cascade and showed that it was the glass of the jar and not the coatings which contained the charge. He discovered the property of points in discharging an electrified body and the identity of lightning with electricity. He also made the first experiments upon atmospheric electricity.

To Canton is due the honor of giving the first experiments of induction, but Franklin is the first who gave the general law of this species of action. Truly our country and this city should honor the memory of this man.

But it is not my purpose to repeat to you in detail the familiar history of our science. Thus far, no important applications of electricity had been discovered; there was nothing but pure science to attract investigators, and thus the science remained for many years after.

But no science is complete unless it is quantitative as well as qualitative. It is now very nearly 100 years since Coulomb laid the foundation of electrostatics and Alpinus and Cavendish commenced to lay the foundation of mathematical electricity, and they were followed by Laplace, Biol, Poison and Murphy.

The discoveries by Galvani and Volta in 1790 and 1800, and by Oersted in 1820, gave us the galvanic battery and electro-magnetism, and it was not until the latter date that any useful practical application was possible. Then, so complete was the science that no factor of other than minor importance was necessary to transmit intelligence from one extremity of the earth to the other.

By the labors of the immortal Faraday, electro-magnetic induction was discovered and the modern dynamo-electric machine became a certainty.

To his other labors, both experimental and theoretical, the modern science of electricity owes much, but it is familiar to all. The name of Faraday needs no eulogy from me, for it stands where it can never be hidden, and the spark which Faraday first kindled now dazzles us at every street corner. No wealth came to him, although he had only to hold out his hand for it. But the holding out of one's hand takes time which Faraday could not spare from his labors, and so the wealth which was rightly his went to others. Who will follow in his footsteps and live such a life, that the thought of it almost fills one with reverence? It is not only his intellect which we admire, it is his moral qualities which fill us with awe, his noble and unselfish spirit.

The name of Faraday brings us down to modern times, whose history it is unnecessary to repeat in detail, especially as there are some now present who have contributed largely to bring the science to its present perfection.

One of the principal features which we remark in our modern science of electricity is the perfection of our means of measuring both electrical and magnetic quantities. In this connection the great names of Gauss and Weber appear, the fathers of the modern absolute system of electrical and magnetic measurement, and that of Sir Wm. Thomson, in no degree less distinguished. On the laws of electric attraction we base our electrostatic system of measurement, and on the magnetic action of the current, the great discovery of Oersted, we base our electro-magtic system and we connect these two systems by that great physical constant, the ratio of electro-magnetic to the electrostatic system of units.

What can be simpler in theory than the electrostatic system, based as it is on the law that electric attraction varies inversely as the square of the distance? We only have to know how the electricity is distributed and its attraction is known. Hence we must select the simplest possible case, such as two parallel discs, and to render the problem calculable, we add a guard ring to the movable disc. We then have the absolute electrometer of Thomson. This gives us a measure of the electric potential. Knowing the capacity and difference of potential of the surface of a condenser, we know its charge. But all these quantities, the calculation of the electrometer and the capacity of the condenser, depend upon the mathematical theory of electric distribution. Are we able to calculate the capacity of condensers of all forms? I am sorry to say we are not. The modern method of treatment is due to James Green, an English investigator, whose name should be held in honor by all electricians. But this method is what is called an inverse one. It is not a method by which we can calculate the distribution on any body at random, but the shape of the body and the electrical distribution on it are both found at once by a species, as it were, of exploration and discovery. So that we cannot make our electrometers and condensers of any shape and then calculate them, but we are forced to make them of some simple geometrical form whose solution is known. We fit our apparatus to the mathematics rather than the mathematics to the apparatus.

But when we have satisfied all the conditions we measure out our static charges as easily as a quantity of matter. The manufacturer sells the oxygen and hydrogen in iron cylinders and determines the amount by the product of the capacity of the cylinders by the pressure. Were there any buyers of electricity we might sell them a Leyden jar full and determine the amount by the product of the capacity of the jar by the electric potential. According to this analogy, then, the electricity is similar to matter and the potential to fluid pressure, while the word capacity has a similar meaning in both.

In the electro-magnetic method of electrical measurement we make use of the magnetic action of the current, either on a neighboring magnet or another current or portion of the same current. The laws of the action of a current on a magnet were discovered by Biol and Savart, and of two currents on each other by Ampère, and the results applied to practical measurement to-day give us galvanometers of all kinds and the electro-dynamometer of Weber. By the galvanometer we can measure the quantity of electricity passing at any moment, but by the electrodynamometer we measure the integral square of the current, a quantity on which the heating of the circuit and the energy expended depends.

Thus the electro-dynamometer measures the energy from an alternating current dynamo-electric machine as easily as from one giving a continuous current, but to know this energy we must know something else besides the integral square of the current, and this is either the resistance of the circuit or the electromotive force. But the measurement of electromotive force depends on a resistance. The question then comes up as to what unit of resistance is the proper one. Here we have to refer to the mathematical theory of the subject, and the great law of the conservation of energy tells us that what is known as the absolute unit of electrical resistance is the proper one for use in this case. Hence the great practical use of determining this unit. The experiments of Kirchoff, Weber, Kohlrausch and the British Association found a value from one to three per cent. too large.

Many years ago I myself experimented on the subject and obtained a result about 4 per cent. too high. Recently Lord Rayleigh has taken up the matter and made a series of experiments of unparalleled accuracy in this line. The International Commission, determined on by the Electrical Congress in Paris, in 1881, met in April of this year at Paris, and has now given us a legal ohm defined as being the resistance of a column of mercury 106 cm. long and 1 mm. in section at 0° C. The length best satisfying the experiments is about 106.25, but it was considered best to use the round number. The experiments which I have been making under an appropriation from the government are now barely completed, but they will probably agree very well with the latter figure. Hence, we can say that we now know this unit of resistance to one part in one thousand, at least. And so we are in a position to measure the energy of a current to the same degree of accuracy, as far as this quantity is concerned.

But to measure a current by the tangent galvanometer one requires to know the intensity of the earth's magnetism, a quantity difficult to determine and constantly varying with time and place. The electro-dynamometer, when made with care, is excellent, but a good one is immensely expensive. Our methods, then, of current measurement are bad, unless carried out in a completely equipped physical laboratory. With a practical standard of electromotive force, such as a Clark's standard cell or a thermo-electric battery, this difficulty partially vanishes. Better, perhaps, we might make simple electro-dynamometers with constants determined by comparisons with a more costly instrument.

But where shall these standards be kept? Evidently the government, which decides on our standards of weights and measures, should take in charge the electrical standards, and possibly also the thermometric standards. The formation of such a bureau of physical standards will be brought to the attention of this conference.

Having given certain standards then, the measurement of currents and current energy becomes easy. The amount of heat generated in a wire of known resistance by a known current is also easily found from the absolute system of electrical measurement.

Besides the two so-called absolute systems of measurement of electricity and electric currents, we have also one based on the chemical action of the current whose laws were discovered by Faraday. Knowing the electrochemical equivalent of some substance we are able to measure the time integral of the current or the total quantity of the current which has passed.

The absolute measurement of magnetism is equally simple with that of electricity, and it is a common observation to find the earth's magnetic force. But Faraday has put in our hands a very simple method of measuring a magnetic field, and to-day all are familiar with his beautiful laws with respect to magnetic lines of force. We know the laws of electro-magnetism and just how many lines of force (better induction) can pass through a piece of iron of given cross section and what is their relative resistance when passing through air or iron. In fact, we have all that is necessary for a complete theory of the dynamo-electric machine, and consequently we find that the latter agrees perfectly with theory and no fact has been observed with reference to it which could not have been foreseen from theory by a person of proper intelligence.

This part of electrical science, the measurement of electrical and magnetic quantities, is thus in a very forward state, based as it is on the mathematical theory of the subject. But, in reality, this forms but a very small portion of our science. Shall we be contented with a simple measurement of what we know nothing? I think nobody would care to stop at this point, although he might be forced to do so. The mind of man is of a nobler cast, and seeks knowledge for itself alone. We are not so base as to be honest because "Honesty is the best policy," neither are we so ignoble as to seek knowledge because "Knowledge is power," two sayings which are certainly true but low and sordid in their tone.

We have, then, the beautiful fabric of mathematical electricity given to the world by Poison, Green, Helmholtz, Thomson, Maxwell, and others whose names are immortal. No hypothesis as to the nature of electricity rests at its base. Starting from the most simple laws of electricity and magnetism, it rises from a stable foundation and rears its form high in air, never to be overturned, whatever the fate of the so-called electric fluid or the ultimate theory of magnetism. On the simple fact that there is no electric force inside a closed conductor, it is proved that the electric attraction and repulsion varies inversely as the square of the distance. This fact is sufficient to give us the whole theory of electrostatic distribution on conductors.

From the simple fact that we can break a magnet up into parts which are similar to each other, and that these parts attract and repel each other in a certain manner, we derive many important facts with regard to magnetism.

From the magnetic action of the current we find, by an application of the great law of conservation of energy, all the laws of induced currents, either from magnets or other currents. By an almost superhuman effort of the intellect we detach our electric currents from matter, and suppose them to take place in the ether of space, and we have the grand electromagnetic theory of light given to us by Maxwell.

But the subject is too vast to be treated in a moment. Suffice it to say that no person at the present day has the right to express an opinion on any theoretical question connected with electricity without a knowledge of its mathematics.

This study has led us to alter our ideas on many questions. What is the mechanism of electric or magnetic attraction? Faraday has given us his idea of lines of force and has made them play an important part in the theory of magnetic induction. When treated mathematically, Maxwell has shown that all electric and magnetic attractions can be explained by a tension along the lines of force and pressure at right angles to them, an idea due to Faraday.

The mathematical theory of these lines shows that all electrostatic forces between either conductors or non-conductors can be explained in this manner. As the laws of magnetic attraction are the same in every way as electrostatic attraction, if we should do away with electric conduction, it follows that magnetic attraction is to be explained in exactly the same manner. In obtaining this result Maxwell calculated the forces acting on the medium at every point, and compares these with imaginary stresses in a medium at the given point. Hence, the energy stored up can be represented either as due to the mutual attraction of the electricity at a distance or to the stresses in the medium at every point, and thus, as Thomson has shown, by a volume integral of the square of the force at every point. Hence, we are at liberty to deny the existence of all action at a distance, and attribute it to the intervening medium, which, to be logical, we must assume to be continuous and not molecular in constitution.

Thomson has pointed out that magnetism must be of the nature of rotation, such as possibly vortex motion in a fluid, and Maxwell has done something toward making a mechanical model of such a medium. Thomson's wonderful address at Montreal has also given us much to think of in the same direction.

But here we have reached the limit of our science, and even that servant of our reason, imagination, fails us. We are yet unable to picture to ourselves what takes place in a medium subject to electrostatic action. We are face to face with the great problem of nature and the questions, what is matter? what is electricity? evoke no answer from the wisest among us. Our mathematics has guided us safely up to a certain point and will guide us still further: science will advance and we shall know more. But, for the present, this is the limit which we have yet attained in this direction. However, the idea of a medium is still serviceable in other portions of our science.

We have seen that the medium explains the electrical and magnetic attraction of bodies at rest. The question then comes up as to what happens in the medium when these bodies move. Are the imaginary stresses in the medium transmitted from place to place instantaneously or do they require time? Mathematics in the hands of the immortal Maxwell has answered this question, and we now know that any magnetic or electric disturbance is propagated through space with a velocity equal to the ratio of the electro-magnetic to the electrostatic unit of electricity. This great physical constant has now been found by experiment to be equal to the velocity of light, and thus has arisen that great modern theory, Maxwell's electro-magnetic theory of light. Indeed, at the present day, so perfectly does this theory agree with experiment that we can almost regard it as a certainty. The velocity of light and the ratio of the units agree far within the limits of experimental error. The fact that bodies having a true (not electrolytic) electric conduction are always more or less opaque, the refraction and dispersion of light, double refraction and diffraction, all are explained on this theory with an ease and simplicity wanting in all other theories; and lastly an electro-magnetic phenomenon has been discovered, which, when applied to this theory of light, explains the rotation of the plane of polarization produced by a magnet. There is no fact in nature seriously in disagreement with this theory, and it serves to connect two of our most important branches of physics, light and electricity.

But some physicists say that it is not a true theory because it is not mechanical, the object of these physicists being to reduce every phenomenon of nature to matter and motion. Whether this is necessary or not I leave to the philosophers. But it is to be noted that the old mechanical theory that light is a vibration in a medium having the properties of an elastic solid is not entirely at variance with the new theory. The medium we call ether. The electro-magnetic theory says that the waves of light are waves of electric displacement, while the old theory says they are waves of ether. Make electricity and the ether equal to each other and the two theories become one. We have arrived at that hazy and unsatisfactory theory of Edlund that ether and electricity are one, except that by this theory electricity is presented to us as an elastic solid!

But the ground trembles beneath us, and we shall soon be plunged in the mire of vague speculation if we do not draw back.

(*Continued on page* 90).

The Electric Lighting of the Louisville Exposition.

BY W. N. MARSHALL.

The gigantic exposition building covers more than 13 acres under one roof, in addition to which there are several outlying buildings, including one of the finest art galleries in the United States—all lighted by the Edison incandescent system. The ground plan of the building is a rectangle with an interior quadrangle after the style of English public school buildings, only that this quadrangle is traversed by two passages at right angles under the roof and which serve to connect the four sides of the building. The extreme dimensions of the building are 900 feet long by 600 feet wide. The ceilings or rather the distance from floor to roof varies somewhat, but is on an average 45 feet. Around each side of the building extends a gallery 25 feet wide. This entire structure, including galleries and art gallery, is lighted by 5,000 Edison lamps of 16 candle-power each. To describe in full detail all that is original in the lighting of this building would require a quarto volume, so we will confine ourselves merely to a general notice of the more prominent points. To say that every detail of this electric light plant, including the running of the wires and location of the lights, is entirely original and created expressly for this purpose, would be only a frank statement of fact.

The entire plant was put in, fixtures were connected, dynamos and engines placed, steam and exhaust connections made, and light successfully turned on in five weeks from placing of the contract. During a portion of the time the Edison Company had 100 men employed on the work. As an example of the thorough and well-defined engineering practice of this company, we would state that when the job was completed the surplus wire left over was less than 300 lbs., so closely had the Edison Company calculated their requirements beforehand. The plant consists of about 5,000 incandescent lamps, each of 16 c. p.; 12 Edison dynamos, each of 450 lights capacity; 6 Armington & Sims steam engines, $14\frac{1}{2} \times 13$. In addition, there is a special arc-light circuit, consisting of one $8\frac{1}{2} \times 10$ Armington & Sims steam engine, one 250-light dynamo, about 250 lamps being so distributed through the building on a special circuit that, when all other lights are extinguished, the building is sufficiently lighted by these lamps to enable the watchmen to find their way around without difficulty.

The system of carrying the current is that known as the circulation system, which allows, with a minimum amount of copper, absolutely no appreciable drop in E. M. F. between different lamps. There are two main distributing circuits, or as the Edison Company have aptly termed them, "cribs," which are each supplied by 7 feeders from the dynamos. The individual lights are each attached to one or the other of these cribs, singly or in groups, by suitable tap lines, each of these tap lines being controlled by a switch to enable them to be lighted or extinguished at pleasure. The 12 dynamos all discharge into one main "omnibus," from which the current is led by the beforementioned feeders to the two cribs. This plant is also run on Edison's 3-wire principle, the use of which necessitates the existence of 3 wires, one being positive, one negative and the other compensating. In this system the entire load of lamps is equally distributed between the positive and compensating wires and between the negative and compensating wires, while any unbalanced load or any difference between the number of lamps on two legs is carried by the compensating wire. This system, which is the invention of Mr. Edison, results in a saving of $62\frac{1}{2}$ per cent. of the copper which would be required to carry the same number of lights on the ordinary 2-wire plan. In the 3-wire system each individual lamp can be lighted or extinguished at pleasure, independently of the rest of the system. In the building all fixtures are of one description, and, briefly, consist of a plain double conductor suspended from ceiling block and at lower end of which is attached one or two or more lamps, as the case may be—each with a suitable shade. These pliable pendants are connected to the mains by means of a fusible wire which quickly melts the moment any more current passes through it than it was designed to carry, thus making the system absolutely safe.

In this connection we would call attention to the fact that neither this year nor last has any accident or any remote approach to a fire been caused by the electric light—a case which is unparalleled by any gas lighting of even much less magnitude. The lamps are all suspended so as to be from 10 to 20 feet from floor, and are so intelligently placed that the whole building is beautifully lighted and absolutely free from all gloomy spots and annoying shadows. This is undoubtedly the nearest approach to pure sunlight that has ever been obtained in any artificial lighting. The main entrances are each illuminated by groups of lamps, prettily clustered under umbrella-shaped reflectors, which throw a perfect flood of soft, ambient light over the immediate approaches.

The appearance of the building at night is indescribably lovely and entirely novel. The incandescent lamps suspended by their frail flexible cords look like so many globes of soft fire, and if in addition they are gently swayed by a breeze, the effect is simply magnificent. The illumination of the Art Gallery is said to be the finest in the world, and must be seen to be appreciated. The lamps are carried in concave metal reflectors around the gallery about twenty inches from top of uppermost pictures, and so inclined as to throw all their light directly on the canvas. By this means the only light in the building is that which is radiated from the paintings themselves. All trying glints and annoying reflections are effectually done away with. The gallery is lighted by 300 lamps, which are carried by a line over 2,000 feet in length to the dynamos.

The dynamos and engines furnishing the energy to this system are a study in themselves. The dynamos are all belted direct from fly-wheels of engines, thus doing away with all intermediate countershafting and slipping belts. They occupy a space 25 feet wide by 150 feet long, and are all grouped symmetrically. The wires from dynamos are led to an overhead platform, where they join into the omnibus first and then diverge into the various feeders. In the centre of the space are located the 12 resistance boxes used to control the brilliancy of the lights, and in front of which the superintendent of the plant stands during the entire run. Here he has before him, by means of galvanometer and lamps, a truthful record of the output and running condition of every dynamo in the plant, and by means of the resistance boxes he is able instantly to correct any machine which may be taking more or less than its proper allowance of the total load. The utmost order prevails and the ease with which the entire plant is handled by one man from this point proves as much as anything else how thoroughly the finest details of the Edison system have been worked up and standardized. No confusion, no misunderstanding of orders, no undue loading of one machine over another. If an order is to be communicated it is done from the superintendent's stand by a shrill whistle, which is understood by the dynamo men, and any order thus given is quickly carried out. There was manufactured for this plant over 50,000 pounds of copper wire. The engines drive at 250 revolutions per minute, and the dynamos at

COL. CHARLES H. BANES.

1100 revolutions per minute. In conclusion I would say that this is the largest isolated plant in the world.

In consequence of the highly combustible nature of the building and its tar roof, the insurance companies refused to take any risk on it if lighted by gas, but they have fully covered it now since it is lighted by the Edison system. The outside lighting is done by the Jenny Co., Fort Wayne, Ind.; a description of that will be given hereafter.

OWING TO THE WAR.—The Eastern Telegraph Company has given notice that the land wires to Tien Tsin and Pekin are interrupted.

ADVANCING THE RATES.—The reports current for some time past that the New England Telephone Company intended to advance its subscribers' rates, are not, says the Boston *Traveler*, altogether without foundation. As yet it is too early to tell definitely how much of an advance will be made, though, as one of the officials of the company puts it, it is safe to say that no telephone will be rented for less than $50 per year. It costs an average of $40 per telephone for maintenance and service throughout New England, and the company cannot afford to do business on the present basis much longer. The business has undergone a wonderful change within the past two years. The lines that were then new require more attention now; the magnetic bells, which were at first repaired at an expense of $1 or $2, have to be replaced now at a cost of $8; and the service has also grown so rapidly that it has entailed many other additional expenses not taken into consideration when the present tariff was decided upon. The company will probably wait, before making the change, until the decision in the Drawbaugh case is rendered, which is now expected early this fall. The arguments will be made about the middle of this month, and the judges' decision is expected very soon after. General Manager Vail, of the Bell Company, is now in Syracuse, and will not return until after the final hearing. General Manager Downs, of the New England Company, will, it is understood, resign on or about Oct. 1, to accept a different and more lucrative position elsewhere. No other change at present is expected. This company, by the terms of the consolidation entered into about a year ago, will have its dividend-earning stock increased during the next four months, $1,400,000.

Col. Charles H. Banes.

We are indebted to Mr. Louis H. Everts, publisher, Philadelphia, Pa., for the portrait and biographical sketch that we are now enabled to give of Col. Charles H. Banes, the indefatigable and popular Director-General of the International Electrical Exhibition.

"Colonel Banes was born in Philadelphia, Pa., Oct. 24, 1831. His education was liberal and his thirst for knowledge has led to the acquisition of a valuable library and of an extensive amount of information upon all questions that interest christians and men of culture. He was engaged in mercantile pursuits until the commencement of the late war, when he gave up the prospects of financial success for the perils of the battle-field and the protection of our national flag. He entered the service as a captain of infantry in August, 1861. At Fredericksburg, in December, 1862, he was promoted to be assistant adjutant-general. He was breveted major, July, 1863, 'for gallant and meritorious services' at Gettysburg. In May, 1864, he was breveted lieutenant-colonel for the same reason. At Cool Arbor, in June, 1864, he received a painful and dangerous wound which confined him to a couch of helplessness and suffering for months, and from the effects of which he can never recover. His last battle compelled his retirement from the army, in which his skill and bravery had been so conspicuously exhibited.

"As soon as returning strength permitted he entered business once more; and now the firm of which he is a prominent and active member owns one of the most extensive and prosperous manufacturing establishments in their branch of industry in the United States.

"Col. Banes wrote a history of the Philadelphia Brigade, for which his scholarly tastes, exact information and personal experiences gave him eminent qualifications. The work has been deservedly and highly commended, and has taken a creditable place in the literature of our great struggle.

"Col. Banes is an untiring worker in various scientific, benevolent and religious organizations, and though the last man to seek prominence in anything, his friends have pushed him forward as trustee of the Franklin Institute, president of the Baptist Social Union, of the Baptist City Mission and of other kindred enterprises. At the last congressional election in his district his political and other friends placed him before the people as a candidate for the House of Representatives, and his popular name secured some twelve hundred more votes than his predecessor in a similar struggle obtained two years before.

"The generous gifts of Col. Banes have already removed heavy church debts and gladdened laborers in other benevolent fields."

We may add to the above that for the last year Col. Banes has given himself up almost wholly to the Exhibition, under the auspices of the Institute.

Uses of the Messenger Service.

In spite of the fun that is made by comic writers for the press of the slowness and dullness of the average District Messenger, there can be no doubt that the services rendered by the boys are such as have already become indispensable to the commercial and social life of most cities and towns in this country. New uses for the "District Messenger" are found daily, as shown by the subjoined.

"I want twenty-five dollars on this," said a District Messenger boy, laying a handsome gold watch on the counter as he entered a pawn shop on Sixth avenue, yesterday.

"Do messengers bring many things to pawn?" was asked of the proprietor.

"You would be surprised to see the number of these boys who bring things here every day. You see, if a lady or gentleman is in want of money, they do not like to be seen going into a pawn shop, so they ring for a District Messenger and get him to go for them."

"It would astonish you to see some of the peculiar errands that messengers are called upon to do in the uptown offices," said a clerk. "Some are asked to carry babies to the ferry; others ride them in the Park; others escort country people through the city to show them the sights; others stay in people's houses to guard them while they are away; others go to the dry-goods store to match silk; others take drunken men home, and so on."

Just then an old lady dressed like a country-woman entered and said she would like to be shown through Central Park. "Next," called the clerk, and a boy about five feet high, with a dejected look and a cap drawn down over his eyes, came forth.

He was posted as to what to do and both went out together. When they were a block away from the office, the boy took the small butt of a cigar from his pocket and asked a man for a light. He struck a lively gait for the Park, far in advance of the old lady, who was striving to catch up with him.

"Are the messengers allowed to smoke while on duty?" was asked.

"No. If they are caught at it they are fined."

TORONTO, CAN.—With regard to the awarding the contract for city lighting, under the circumstances narrated in these columns last week, we now learn that the Canada company applied for an injunction to restrain the city from signing the contract with the Toronto company. The injunction was denied with costs.

The Science Congress at Philadelphia.

No sooner has the British Association closed its meetings at Montreal than the American Association for the Advancement of Science goes into session at Philadelphia. The latter body was called to order for its thirty-second annual session on the 4th inst., at 10:30 A. M., by the retiring president, Prof. Young, of Princeton College, in the Academy of Music in that city. After the opening prayer, Prof. Young introduced the new president, Prof. J. P. Lesley, of the University of Pennsylvania, who took the chair with a few appropriate remarks. Governor Pattison, of Pennsylvania, then made the address of welcome from the State to the assembled scientists of the world, and referred to the two great men who had so signally honored the Keystone State—Fulton and Franklin. Mayor Smith, of Philadelphia, then delivered the address of welcome from the city. Professor Lesley responded, and in doing so recalled the fact that the Association was virtually, though under another name, born in Philadelphia in 1832. He concluded thus:

"This thirty-third meeting, probably the largest and most successful of all its meetings, graced for the first time by the presence of the representatives of a large number of sister associations, as well as the British Association for the Advancement of Science, and a considerable number of delegates from other societies, coming not only from the remotest corners of Christendom but from the Orient and Indies as well. Therefore the Association, as I have said, meets here as a child returning to the house of its fathers; and the welcome of the Governor of Pennsylvania and the Mayor of Philadelphia is only one which it would be natural for the delegates to look for. Gentlemen, on behalf of the Association, I thank you."

The secretary, F. W. Putnam, read a long list of foreign societies represented at the proceedings.

A cablegram was at this point received from the French Association for the Advancement of Science, in session at Blois, France, expressing friendly feelings and containing wishes of prosperity and success to the fraternal society of America. The following reply, which had been intended as a first dispatch, was at once sent by cable to Blois:

"The American Association, in session at Philadelphia, the home of Franklin, greets the French Congress in session at Blois, the birthplace of Pepin. May steam and electricity join in proclaiming and realizing the ideas of science and unite the nations in good will for the welfare of all mankind."

An incident which provoked applause was the reading of a letter from Mrs. Elizabeth Thompson, of Sanford, Conn., inclosing a $1,000 check for experiments in communicating light and heat under the directions of the society.

An invitation for the body to attend the Electrical Exhibition on September 10 was accepted.

The president announced as the committee upon an International Scientific Congress: Professors Newcomb and T. Sterry Hunt, G. F. Barker, C. C. Pickering, T. W. Powell, Ira Remsen and C. S. Minot.

The sections took up their routine of business in the afternoon. Prof. John Trowbridge addressed the physics section on the nature of electricity.

At the general session of the Association on the 5th, at the Academy of Music, Professor Minot arose and brought up the most interesting and important subject of the morning. It was a petition in relation to the proposed organization of an International Scientific Congress. The petition was signed by eight past presidents and many members of the American Society and by several prominent members of the British Association for the Advancement of Science. It read: "We respectfully request the British Association for the Advancement of Science and the American Association for the Advancement of Science to consider the advisability of forming an international scientific association, to meet at intervals in the different countries, and, if it should be found desirable, to take measures to initiate the undertaking." Professor Minot said that the matter had been referred for consideration to Professors Newcomb, Hunt, Barker, Pickering, Powell, Remsen and Minot (himself). He added that nothing could be done with respect to the matter by the Association until the committee had made a report. If the committee were to take its cue from the demonstration made by the assemblage of yesterday it will make a favorable recommendation in short order. A similar petition presented to the British Association was referred for consideration to Sir William Thomson, Sir Lyon Playfair and Vernon Harcourt. They will before coming to a final decision confer with the American Society's committee. The general session was adjourned and the sections met immediately afterwards in their respective quarters.

The section of physics assembled in the chapel of the Episcopal Academy. Prof. John Trowbridge, of Cambridge, Mass., acted as chairman, and N. D. C. Hodges, of Salem, Mass., as secretary. Among the papers presented or read were: "On the Fritts selenium cells and batteries," by Charles E. Fritts; "Relation of the electromotive force of a Daniel cell and the strength of the zinc sulphate solution," by H. S. Carhart; "Note on the periodic modification of electro-static induction," by H. S. Carhart; "Description of a galvanometer for demonstrating the internal current transmitted through the liquid with a voltaic cell," by Conrad W. Cooke; "On the variation of the resistance of carbon under pressure," by T. C. Meadenhall; "Upon a generator in use at Cornell University for producing oxygen and hydrogen gas by means of the dynamo machine," by W. A. Anthony.

In the section of economic science and statistics, meeting in the hall of the Historical Society, a paper was presented by P. H. Dudley on "Brief outlines of the investigations upon the power to move railroad trains and the mechanical inspection of railroad tracks, as made by the dynagraph and track inspection car (with electric attachments)."

The reception that was tendered in the evening at the Academy of Music by the citizens of Philadelphia to the members of the American and British Associations for the Advancement of Science, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, and to the visiting delegates from other home and foreign scientific bodies, was a brilliant success. It was the occasion for a great, and to the delegates no doubt, a very gratifying display of that cordiality and hospitality for which the Quaker City is proverbial.

Dr. William Pepper, in the course of his address as chairman of the committee of invitations and receptions, said with regard to the late Sir W. Siemens:

"It is true that with each year there is increasing public appreciation of the work and claims of scientists. We have but recently seen the gates of England's great abbey open to receive among her famous dead not only the immortal Darwin, but another whose claim to entrance there was that he had been the chosen and fitting representative of England's scientists. But in this country there is needed more practical and immediate expression of this rising appreciation. Science itself is ultimately practical and profitable; but with no such motive as that of profit or immediate utility must the true scientist pursue his researches. Nor can we afford to delay the formation of such ample endowments as will enable the gifted and disinterested men whom we expect to advance our national scientific fame to prosecute their labors; and which will render our great universities true centres of fruitful scientific work, extending their influence throughout the world.

"The importance of this endowment of scientific research is, to my mind, one of the greatest lessons of this interesting occasion; and I have gladly availed myself of the opportunity of alluding to it while discharging the grateful duty of extending to you, as I now do, a most cordial welcome on behalf of the scientific workers of Philadelphia, of whom, whether of the past or of the present, I am proud to be able to say that they include many whose name and fame the world will not willingly let pass away."

Prof. Young, as retiring president of the Association, read the annual address, his subject being "Pending Problems of Astronomy." One passage was as follows: "The face of science has greatly changed in the meantime, as much, perhaps, as this great city and the nation. One might almost say that since 1848 'all things have become new' in the scientific world. There is a new mathematics and a new astronomy, a new chemistry, a new electricity, a new geology and a new biology. Great voices have spoken and transformed the world of thought and research as much as the material products of science have altered the aspects of external life. The telegraph and dynamo-machine have not more changed the conditions of business and industry than the speculations of Darwin and Helmholtz and their compeers have affected those of philosophy and science."

The Late Mr. Volckmar.

To the Editor of The Electrical World:

SIR: The letter in your issue of the 2d inst., signed by the singularly inappropriate *nom de plume* "Verax," is such an obvious jumble of fact and fiction that it might well pass unnoticed were it not that some of the misstatements might at a future time be referred to as a matter of history in connection with electrical accumulators, and might possibly be considered by some who are ignorant of the facts as prejudicial to the interests of my company if they remain uncontradicted.

It is not within my province to touch upon the private affairs of the late Mr. Volckmar; what is presumably of interest to your readers are the statements made in connection with the "accumulator patents" viz., that the "Sellon-Volckmar" accumulator is simply a reproduction by a friend of Mr. Volckmar's (Mr. Gustave Philippart) of improvements made by Faure, worked out under the auspices of Mr. Sellon.

It is right to place on record that Mr. Sellon, who took out his important and comprehensive patents in September, 1881, never heard of the name even of Mr. Volckmar or of Mr. Gustave Philippart, until some months afterward, viz.: in December of that year, when Mr. Volckmar was presented with introductions of a high class to him and to other gentlemen interested in electrical matters in England.

The inventions were made quite independently of each other and effected in different countries, Mr. Volckmar having worked entirely in France, and his specification was taken out a month later than Mr. Sellon's, viz., in October, 1881.

The association of the two names is incidental to the fact that the Electrical Power Storage Company secured both patents, together with Mr. Swan's and others, and subsequently the Faure patents—the combination covering the whole ground of electrical accumulators.

The assertion that the Sellon and Volckmar patents are in any way infringements of the Faure, should not be allowed to pass unnoticed, although as my company possesses them all, it is not material. The fact is, however, that of the several claims not one is in common, but it is a well authenticated fact that the Faure patent without the combination of the Sellon-Volckmar is impracticable, and that its entire value is given to it by such combination.

ELECTRICAL POWER STORAGE CO., Limited,
LONDON, Aug. 26, 1884. H. DELL, Secretary.

Science in Fairy Tales.

To the Editor of The Electrical World:

SIR: Hans Christian Andersen, the renowned story-teller, is entitled to a page in the history of the telephone, as being one of the first to propose transmitting musical sounds to great distances by means of electric wires.

In one of his works, "Sein Oder Nicht Sein" ("To Be or Not to Be"), published by "L. Wiedeman," Leipzig, 1857, he expresses through his hero, Nils Bryda, the belief that in a few years the thing will be accomplished.

The scene is laid in Copenhagen, during the cholera of 1851, thus twenty-five years before Bell's telephone and twelve or thirteen years before Reis produced his invention. The original may be found on page 84, part 3.

"I doubt not," said Nils Bryda, in a joking tone, "that the spirit of genius will, in a few years, have discovered so much that the great virtuosi need not come to us personally any more. Thus, Liszt, Thalberg and Dreyschuck will make use of the electro-magnetic strings (wires), which will be connected to the piano; then we go to the theatre here in Copenhagen and sit here. Liszt sits in Weimar, Thalberg in Paris, Dreyschuck in Prague, and they play two, four and six-handed, and we listen to the concert. The applause must naturally be telegraphed to the virtuosi, as also every wish for a da capo" (free translation).

It will be seen that Andersen only thought of transmitting musical sounds in one direction, and had no idea of speaking over a wire, as he says the applause, etc., *must* be telegraphed.

Mr. Berliner will probably rejoice to find another "original" telephonist, and no doubt many of your readers will be surprised to find that Andersen could give a little time to practical reflection, as his name is only associated with fairies, ghosts and goblins, in most minds.

ST. PETERSBURG, Russia. JOHN CRAWFORD,
Chief Engineer International Bell Telephone Co.

[Mr. Crawford's letter is interesting. But the great Danish writer was not the first of his craft to use this telephonic idea. Last April we called attention to a passage in a fairy tale called "The Good Genius that turned everything into gold," by the Brothers Mayhew, published in London in 1847. The little Bee informed the Queen that the "metallic threads" running through the air above would "convey any message you please." The Queen told the Bee what to say, and the "words went tearing through the atmosphere on the wings of the lightning messenger." The passage is accompanied by a snatch of poetry in which the whole telephonic idea is given:

"Let their voices be heard
At a distance no voice could reach!
And swiftly as thought
Let the words be brought,
And the lightning endowed with speech!"

This is far broader than Andersen's conception.—EDS. E. W.]

Government Telegraph Rates.

The postmaster-general, acting under the provisions of the act of July 24, 1866, which requires the postmaster-general annually to fix the rates to be paid for government telegraphing, issued on Sept. 4 an order fixing the rates for the remainder of the current fiscal year as follows: For day messages of not exceeding 20 words, exclusive of the date, 20 cents for all distances within 1,000 miles, with an additional charge of 5 cents for every additional 250 miles or fraction thereof, but for no distance is the rate to exceed 50 cents. For night messages of not exceeding 20 words, exclusive of date, 15 cents for all distances below 2,000 miles, and for greater distances 25 cents. For both day and night messages an addition of one-fifth the rate is to be made for every five words or fraction thereof in excess of 20 words. For cipher messages, known as Signal Service weather reports, the rate shall not exceed 3 cents per word sent over each circuit as now or hereafter established by the chief signal service officer of the army, and all such messages are to be dropped at such intermediate points as may be designated without extra charge. It is further provided that in no case shall the government be charged higher rates than the public is charged for the same service. The rates paid for government telegraphing have heretofore been reduced several times, but the reduction ordered is the greatest made in any one year or series of years. The rates promulgated are those reported by the Senate Committee on Post Offices and Post Roads last winter in their postal telegraph bill.

National Conference of Electricians.

(*Continued from page* 87.)

Among the other questions which depend for their solution on the presence of a medium, may be mentioned the mutual action of two electrified bodies moving in space. It has been found that electricity carried through space on a charged body has exactly the same magnetic effect on a stationary magnetic needle as if it had been conducted.

But when electrified bodies move uniformly forward in space we can conceive of no mutual effect from such motion unless it is relative to a medium. For we cannot even conceive of absolute motion.

Assuming the medium to exist we then know that a positively and negatively charged body flying through space with the velocity of light would have their electric attraction just balanced by their magnetic repulsion, and so would exert no force on each other.

But it is a most wonderful fact that we have never been able to discover anything on the earth by which our motion through a medium can be directly proved. Carried as we suppose by the earth with immense velocity through regions of space filled with ether, we have never yet been able to prove any direct influence from this etherial wind.

The assumption of a medium allows us to solve in some cases that problem so long under discussion by electricians —namely, the true velocity of an electric current. We now know that the term velocity hardly applies to this case, and that the current arrives at different points so gradually that we know not when to say it has arrived. But there is certainly a minimum time when even an infinitessimal current can reach a distant point. Suppose two wires stretched in space with their ends near together at one end and a Leyden jar be discharged from one to the other at the near end. The *minimum* possible time of obtaining a spark at the distant end will evidently be the time required by light to pass from the Leyden jar to the distant point, not around the wire, but in a straight line. In this case the greatest maximum velocity is thus twice that of light reckoned around the wire, and may be any amount greater when we bend the wire. For all ordinary distances this velocity may be considered infinite, and the retardation to depend only on the electrostatic capacity and magnetic self-induction of the wire. Treated in this way, we have Thomson's mathematical theory of the propagation of an electric wave along a telegraph wire or cable, a theory of great practical use in telegraphy and telephony. But until the action in the external medium is also taken into account, it can only be considered an approximation. For we can never move a magnet, discharge a Leyden jar or complete the circuit of a battery, without causing a wave of electromagnetic disturbance in the ether, and every signal which is sent along a telegraph line is accompanied by a wave in the ether, which travels outward into space with the velocity of light. Truly, the idea of a medium is to-day the keystone of electrical theory, but we can hardly suppose that it has even yet attained a fraction of the importance to which it is destined to rise.

Let me now call your attention to one of the most wonderful facts connected with electrical science. When we are dealing with the electrostatic action of electricity, we find that it is the so-called electric fluid which attracts the opposite. Not only do we observe the attraction of bodies oppositely charged, but the electricity itself on the two bodies is displaced by its mutual action. But when we come to investigate the mutual attraction or repulsion of electric currents on each other, we find an entirely different law. In this case the conductors carrying the currents attract or repel each other, but the currents within those conductors have no influence of attraction or repulsion to displace themselves within the body of the conductor. In other words, the current is not displaced by the action of a neighboring magnet, but flows on calmly as if it were not present.

This to me is one of the most wonderful facts in electrical science, and lies at the foundation of our science. It cannot be ignored in any further progress we may make in electrical theory, but points out a radical difference between electrostatic and electro-magnetic action.

I have said there is no action of a magnet in displacing an electric current, and have thus stated the broad general fact, and which is perfectly true in some metals. But in others there is a small action which changes in direction with the material. The elements of the electric current within the material are rotated around the lines of magnetic force, sometimes in one direction and sometimes in the other, according to the material. But the action is, in all cases, very weak. When applied to the electromagnetic theory of light, this action leads to the magnetic rotation of the plane of polarization of light. As to the explanation of both these actions, Thomson has remarked in the case of light, from dynamical considerations, the rotation can only come from a true rotation of something in the magnetic field, and leads us to think of all magnetic action as of the nature of vortex motion in a fluid. But here our theory ends for the present. We have obtained a clue, but it is not yet worked up.

I have now taken a rapid glance at some of the modern advances of electrical science, and we have not yet had to give up the old idea that electricity is liquid. To the profound thinker this idea is very vague, and there are some facts at variance with it, but it is still useful. We often hear persons say that this old idea is gone, and that electricity is "force," whatever they may mean by that. But let us see. The work or energy of an electric current between any two points is the quantity of electricity passed multiplied by the potential; this work goes to heating the wire. Let a current of water be passing in a pipe and the quantity of water multiplied by the difference of pressure between two points gives us the work which has been done in the intervening space, and which has produced heat. The analogy is complete. No electricity has been destroyed in the one case, or water in the other, but the work has come from the fall of potential in the one case, and the fall of pressure in the other; the resultant is the same in both—heat. Again, we can obtain work from the mutual attraction and repulsion of electrified bodies, and the work in this case always comes from the change of potential between the bodies while the electric charges remain undisturbed in quantity. Electricity, then, is not energy, but is more of the nature of matter.

So far for electricity in the state of rest or steady flow. But when it changes from rest to motion, all known liquids have a property known as inertia; furthermore, they have weight. But the electric fluid has neither inertia nor weight as far as we have yet experimented, and in this respect differs from all known matter. Furthermore, we have never yet been able to separate electricity from ordinary matter. When we pass electricity through a vacuum, the resistance becomes less and less, and one may have hopes of finally having an electric current through a vacuum. But, as the exhaustion proceeds, we observe that the resistance begins to increase until it reaches such a point that no discharge can take place. Electricity cannot exist then without matter, a fact fatal to the idea of a fluid, however useful that may be. We have but one conclusion from this, and that is that *electricity is a property of matter*. Do with it what we may it can never be separated from matter, and when we have an electrical separation the lines of force must always begin and end in matter.

The theory of matter then includes electricity and magnetism, and hence light; it includes gravitation, heat and chemical action; it forms the great problem of the universe. When we know what matter is, then the theories of light and heat will also be perfect, then and only then shall we know what is electricity and what is magnetism.

It is the problem of the universe which *looms* up before us and before which we stand in awe. The intellect of the greatest among us appears but feeble, and we all, like Newton, appear but as children on the seashore. But how few of us find the shells which Newton did, and how few of us try. The problem is vast and the means for its solution must be of corresponding magnitude. Our progress so far has been but small. When we push our inquiry in any direction we soon reach a limit; the region of the unknown is infinitely greater than the known, and there is no fear of there not being work for the whole world for centuries to come. As to the practical applications which await us, the telegraph, the telephone and electric lighting are but child's play to what the world will see in the future.

But what is necessary to attain these results? We have seen how the feeble spirit, which was waked up by friction in the amber and went forth to draw in light bodies, has grown until it now dazzles the world by its brilliancy, and carries our thoughts from one extremity of the world to the other. It is the genius of Aladdin's lamp which, when thoroughly roused, goes forth into the world to do us service, and returns bearing us wealth and honor and riches. But it can never be the servant of an ignorant or lazy world. Like the genius of Aladdin's lamp it appeared to the world when the amber was rubbed, but the world knew not the language in which to give it orders, and was too lazy to learn it. The spirit of the amber appeared before them to receive its orders, but was only gazed at in silly wonder, and retired in disgust. They had but to order it and it would have gone to the uttermost part of the earth with almost the velocity of light to do their bidding. But in their ignorance they knew not its language. For two thousand years they did not study it, and when they then began to do so, it took them 250 years to learn the language sufficiently to make a messenger of it. And even now we are but children studying its A B C. It is knowledge, more knowledge, that we want.

I have briefly recounted the advances which we have now made in one science, and, however beautiful it may appear, we have soon reached the limit of the known, and have stood in wonder before the vast unknown. For very much of our science we see no practical applications, but we value it no less on that account. We study it because we have been gifted with minds whose exercise delights us, and because it seems to us one of the highest and noblest of employments. And we know by the history of the past that the progress of the world depends on our pursuit, and that practical applications, such as the world has never even conceived of, await us. It is necessary that some should go before to clear the way for the world's advance.

This is the work of the pure scientist; to him the problem of the universe is worth devoting his life, and he looks upon wealth as only adding to his means of research. He hopes not to solve the problem himself, but is contented if he may add some small portion to human knowledge; if he may but do his part in the march of human progress. He looks not for practical applications, but he knows full well that his most abstruse discoveries will finally be made useful to mankind at large, and so troubles himself no further about it.

The science which he creates is studied by others. Their minds are educated by it and their hearts entranced by its beauties. And some are led to devote their lives to its further advancement. But the whole world benefits by it intellectually. The wayward spirit of the amber has vanished forever, and prosaic, law-abiding electricity has taken its place even in the estimation of the most ignorant. The world has advanced, and in great part from the study of science.

Then comes the practical man who sees that other benefits can be reaped besides those of pure intellectual enjoyment. While the investigator toils to understand the problem of the universe, the practical man seeks to make a servant of our knowledge. He seeks to increase the power of our bodies and so make the bonds by which the mind is united to it less irksome. It is he that increases the wealth of the world and thus allows those so disposed to cultivate their tastes and to elevate themselves above the savages. The progress of the world depends upon his inventions.

Let not, then, the devotee of pure science despise practical science, nor the inventor look upon the scientific discoverer as a mere visionary person. They are both necessary to the world's progress, and they are necessary to each other.

To-day our country, by its liberal patent laws, encourages applied science. We point to our inventions with pride and our machinery in many of the arts is not surpassed. But in the cultivation of the pure sciences we are but children in the eyes of the world. Our country has now attained wealth, and this wealth should partly go in this direction. We have attained an honorable position in applied science, and now let us give back to the world what we have received in the shape of pure science. Thus shall we no longer be dependent but shall earn our own science as well as inventions.

Let physical laboratories arise; let men of genius be placed at their head, and, best of all, let them be encouraged to pursue their work by the sympathy of those around them. Let the professors be given a liberal salary so that men of talent may be contented. Let technical schools also be founded, and let them train men to carry forward the great work of applied science.

Let them not be machines to grind out graduates by the thousand, irrespective of quality. But let each one be trained in theoretical science, leaving most of his practical science to be learned afterward, avoiding, however, overtraining. Life is too short for one man to know everything, but it is not too short to know more than is taught in most of our technical schools. It is not telegraph operators but electrical engineers that the future demands.

Such a day has almost come to our country and we welcome its approach.

Then and not till then should our country be proud and point with satisfaction to her discoveries in science, pure *and* applied, while she has knowledge enough to stand in humiliation before that great undiscovered ocean of truth on whose shores Newton thought he had but played.

When the applause had ceased, Sir Wm. Thomson was called upon, and responded amidst very hearty manifestations of esteem from the audience.

ADDRESS OF SIR WM. THOMSON.

In the beautiful address which has been delivered, we have an admirable exposition of the relations between pure science and the applications of science to the wants of mankind. We have had a beautiful vindication of the independence and dignity of pure science, and we have had a most liberal and intelligent exposition of the action and reaction of those two great forces continually having effect in respect to the relations between pure and applied science.

In the illustrations which we have heard with so much interest from the life and doings of Archimedes, from the sayings and discoveries of Newton, and from the model life of a philosopher presented to us by Faraday, we have seen how, in every case, science for its own sake must be the great object; how love of truth and the discovery of truth must be the reward, the ambition and the solace of the investigator. But we have also seen how closely the applications of science are related to scientific discovery. Archimedes despised his warlike engines. I doubt not that if we could see into the heart of hearts of that great man, we should find him regretting that science should be applied in any way in the art of destruction, even though that art of destruction was for the noble application to self-defense against an aggressor. I doubt not but that Archimedes, in his mind, looked forward to a better time when science should be applied, and great engines should be devised for other purposes than that of infliction of wounds and death even on the enemies of your beloved country. In his own mind, Archimedes perhaps scarcely recognized how much benefit his pure science derived from the necessity under which he felt himself to apply it to practical purposes. He could not go through his great work of devising those warlike engines for throwing stones and battering down walls without investigating and finding out the laws of dynamics. He could not invent his great burning machine without studying the laws of optics, and how much of his own science, that he loved more than anything else, came from the necessity of finding ways and means of doing that which was necessary for himself and his fellow countrymen in their great distress, I think probably he scarcely recognized it in his own mind.

Newton, again, passed the last half of his life as an engineer, virtually, in the service of the State as Master of the Mint. Nothing is to be so deeply regretted in Newton's career as that the last part of his life was so absorbed in his work for the public service that he was prevented from carrying out some of his great investigations. His sense of duty was so strong, his conscientiousness so much a part of himself, that he would not listen to any attempts on the part of those interested in science to call him back to purely scientific investigations. The work must be done. He must vindicate the credit of the nation in issuing good coins which should be one hundred per cent. of their face value. In his great effort he was seconded by another man of transcendentally philosophic character, Locke, who ultimately led the British Government to prohibit the use of clipped coins, or anything less than its face value, and at a great national sacrifice to call in all the coin which was under weight, and issue coin of true value for it.

The work of a great mathematician and a great philosopher, applied to a matter of abstract justice, is here purely and interestingly exemplified. But alas for science that Newton should have been Master of the Mint, and only Master of the Mint, for the last years of his life. We have had, indeed, some evidence, new to the world, brought recently before the British Association at Montreal, to the effect that Newton really had done many things that do not appear in his "Principia" or in his "Optics," or in his "Universal Arithmetic," or in any of his works hitherto published, and that a sense of public duty alone prevented him not only from going on and investigating more, but even kept him from publishing that which he had done, and which remains in manuscript to this day, proving that he was far ahead of anything that was then known in respect to some of the principles in physical astronomy and optics that have been worked out since his time by persons following in his steps.

I say that this Electrical Conference, of which this is the first meeting, is to be viewed as a piece of liberal progress of the nineteenth century of the great nations of Europe and America, according to which science and its practical applications go hand in hand and mutually act and interact beneficially. If there had been an electrical conference, an international bureau of weights and measures, an international society of astronomy in Newton's time, all that Newton did for his countrymen in the way of improving the coinage and improving the mechanics and engineering of the mint would have been done, and a great deal that he left undone, and a great deal that his powers and genius allowed him to do, might have been done, and we might have had the fruits of that to this time.

An Electrical Conference, such as we are now entering upon, with the objects that have been put before us by Professors Newcomb and Rowland, is of the most superlative use, not merely for the practical purposes for which it is designed, but for the recognition of applications to practical purposes, which all men, who cultivate science, must feel to be most potent in guiding their own work, even in the most transcendental regions of thought. The special objects of this International Conference are partly carrying out, and partly expanding those which have been put forward by a committee of the British Association as long ago, I think, as 1862, and then again by the Conference of Electricians in Paris, which was held in the years 1881–82–83.

The introduction of an international system of electrical measurement, as it has been spoken of by Prof. Rowland, is one of the most important subjects that will come under discussion of this Conference.

Another very, very important object is the laying out of international standards. That is a matter of the most superlative importance for the scientific worker, as well as for the engineer. It is as necessary that we should be able

to measure electricity as it is that we should be able to weigh out quantities of tea and sugar, fish, meat, etc. We have, for example, a spring balance for weighing fish, a gigantic balance for weighing a loaded truck of seven or ten tons. Those are the basis of weighing and measuring masses by gravitation, which are well carried out in ordinary life. Quite corresponding aids, only through a wider range, are wanted for electricity. The smallest weights that the chemist needs amount to one tenth to one-hundredth of a milligram; the gram is a thousand times as large, and a ton is one hundred million times as large. In ordinary weighing, we want to weigh from a very small quantity, say one-hundredth of a milligram, to one hundred times as much. We want to do the same thing in electricity. The vast and intricate developments of electrical science on the one hand show us the thousandth or hundred thousandth of an ampère, as in the splendid experiments which have been made on solar radiation by Langley in his bolometer.

Rowland's investigations on the magnitude of the ohm help to give us the foundation to bridge over the absolute measurement of currents—such as those of Langley's—which require the determination of the hundred thousandth, or the millionth of an ampère, to the current of an incandescent lamp, such as an Edison lamp of six-tenths of an ampère, and the current of five thousand ampères. When we have a central station, such as that which is so admirably worked out by Edison, and which will come to be worked out more and more, in New York and all cities of the world by which one large station shall give light to every place within a quarter of a mile of it; the wants of practical measurement for electricity will correspond quite in magnitude to the wants of ordinary weighing.

We want not only instruments that shall be as convenient as the fishwife's spring balance for weighing fish or the quick automatic balance for weighing a railway truck; but we want quick, accurate instruments, prepared from absolute standards. As has been stated by Prof. Rowland, the comparison of practical instruments with absolute standards is one requiring the superrefinement of scientific methods, and the hardest work of the scientific investigator in his laboratory.

Lord Rayleigh has done this to a remarkable degree. He has produced an absolute electro-dynamometer free from the objections that Prof. Rowland has spoken of with regard to the difficulty of measuring the continually varying wave of terrestrial and magnetic force.

This instrument is now in the Cavendish Laboratory in Cambridge, Eng. The comparison of this with other instruments requires the diffcult transportation of instruments, or the very difficult method of electro-chemical measurement which has been described to us.

The great object of an international conference must be the laying out of convenient standards—a convenient, absolute millo-ampère-meter, and a convenient, absolute hecto-ampère-meter which will measure a few hundred ampères in a convenient way. The establishment of such instruments in all the cities of the United States and Europe is one of the first objects of the Electrical Conference. We must not hope too much from this one conference. If it opens the way to carrying out such an object, those who have worked as some have done for the public good in the way of promoting the institution of this conference will have their reward.

I fear I have taxed your patience too long, but I cannot sit down without again reflecting on the men whose lives have been patterns to the world. There is none more remarkable perhaps than the man of this country, Joseph Henry, who ended his days here. He and Faraday were patterns of scientific investigators. In some degree they went parallel and made similar scientific discoveries. Henry, indeed, preceded Faraday in the great discovery of the electro-magnetic induction between unmoved conductors. Henry gave the warmest welcome to all practical applications of his discoveries. He sought to make none himself, not because he superciliously despised the applications of science to the public good, but because his own convictions constrained him to go on in pure science; because he felt, as Prof. Rowland has said so well in respect to Faraday, that it would have taken him from his work to have devoted himself at all to the practical applications of his discoveries. But what a beautiful trait of character it is to see what a kindly welcome he gave to those who did make the practical applications. He saw what might be done, but deliberately left it to others.

I know no other parallel to Henry's action in this respect except that of Faraday himself. The beautiful and simple manner in which Faraday describes the dynamo, which is making such a mechanical and engineering revolution in the world, is remarkable: "Put a little more wire together, make the thing a little larger, and there is a vast power there, competent to do great things." I wish I could remember his words. He says in the very simplest manner that he must leave this to others. "I have to go on; I have something before me that I must do. This will be done. This will come perhaps, but not by me." I have only been able to clumsily repeat the idea in ten times the number of words, as I remember it, from reading his paper a long time ago. He thought little of the practical application; but it was not one of those gifts given with an off-hand generosity, because the giver did not value it. Faradap valued the practical application. He was, like Newton, in the public service as an engineer. He was scientific adviser to the English Board of Lighthouses, as Henry was scientific adviser to the U. S. Board of Lighthouses.

The friendly welcome that Faraday gave to the dynamo is quite refreshing to think of. When he was first shown a great dynamo with power enough to produce the electric light he said: "I gave it to you as an infant and you bring forward the child as a giant." No one took a greater pleasure in the application of his science than Faraday. He was content to stand by and see the great results that were obtained, while he remained at work in the Royal Institution to the very end of his working days, trying to see deeper and deeper into the properties of matter, and trying to penetrate further along that line of investigation you have heard described so admirably by Prof. Rowland, the relation between electro-magnetism and gravitation.

I must say, in conclusion, that I greatly wish success to the Electrical Conference in its two-fold object of promoting the useful applications of science to the ordinary wants of man, and, on the other hand, to give tone and character and vigor, in one respect, to the purely scientific investigator, and to give him means of observing and seeing, to bring forward to him suggestions, which the most ardent student in the laboratory or the mathematician in his retirement could scarcely arrive at without observations of the phenomena, which are brought before him in these great applications of science, such as we see now in electric lighting and electric transmission of force by the dynamo electric machine.

No further business was transacted at this session. The conference adjourned immediately after the meeting to 3 P. M. on the 9th.

The Young Speed Indicator.

Part of the exhibit of the Electrical Supply Company at the International Electrical Exhibition, is a new speed indicator, known as Young's patent, and manufactured by Messrs. Elliott Bros., of London, the celebrated instrument makers. We illustrate it in the two accompanying cuts. The description furnished us is as follows:

Fig. 1 represents a side view and Fig. 2 a plan showing the transmitting mechanism. This consists, among other things, of a ball governor. The wheel *B*, besides forming an attachment for the arms *N N*, is furnished with a groove in which work the arms *C C*. These are connected to an upright rod, at the upper end of which is another arm *D*; *E* is a horizontal piece fixed to the arm *D* and the screw *F*; *G* is a toothed sector in which a slot is cut, as shown in Fig. 2, through which the screw *F* extends. This slot serves for adjusting the instrument, the screw *F* being made so that it can be fixed in any part of the slot. The sector *G* gears with a pinion, the axis of which operates the index. *P* and *O* are toothed wheels fixed to the spindles *K* and *L* respectively. The face of the instrument has two concentric circles marked on it, the inner circle denoting speeds between 100 and 500, and the outer circle speeds from 400 to 2,000 revolutions per minute. The circles are divided off into divisions representing five revolutions; these divisions are not equal, but increase gradually up to the division that marks the maximum speed which the instrument will indicate. The pointer *M* being placed on the spindle *L*, if we know that the speed of the machine is between 100 and 500, or on

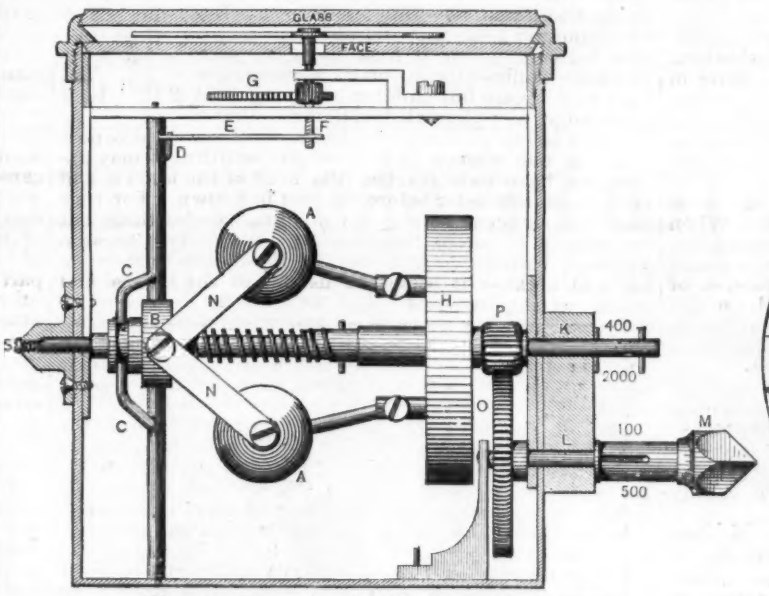


FIG. 1.—VERTICAL SECTION AND ELEVATION.

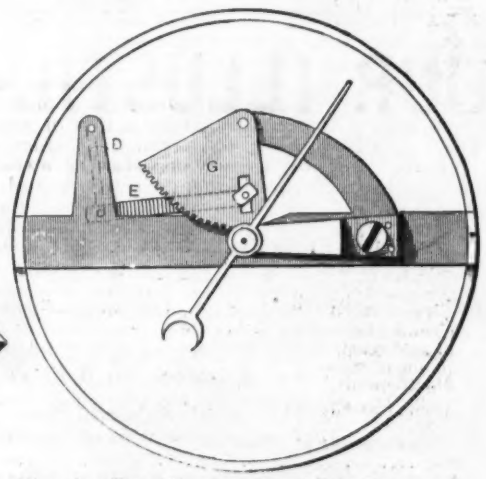


FIG. 2.—TOP VIEW, WITH DIAL REMOVED.

K if the speed is between 400 and 2,000, is now applied to the centre of the shaft whose speed we wish to determine. The centrifugal force causes the balls *A A* to fly out, moving the wheel *B* to the right, and hence causing the arms *C C* to swing around, which motion is transmitted through *D* and *E* to the sector *G*. This turns the wheel to which the index is fixed. The governor is not fixed on the spindle, the friction between the two causing the governor to turn for the least turn of the spindle. The spring on the spindle *K* brings the index back to zero. Tests are to be seen with the indicator at the Exhibition, and they give good results.

American Association Notes.*

In continuation of our report on page 82 we give reports of the following papers read before the physical section of the Association:

4. On the variation of the resistance of carbon under pressure. By T. C. Mendenhall.

About two years ago, in a brief paper read before the meeting of the National Academy, I called special attention to the influence of time on the change in the resistance of the carbon disc as used in the Edison transmitter. I had occasion at the conclusion to refer to some investigations on the resistance of carbon under pressure that had been made by Professors Tomlinson, Sylvanus Thompson and Barrett, and to make the remark that the theory which had been suggested by these gentlemen to account for the variation of the resistance was not sufficient to entirely account for the facts. These gentlemen affirmed that it was an alleged effect due solely to the variation of the contact resistance between the electrodes on which the carbon buttons were placed and the electrodes themselves.

A somewhat pronounced notice of this paper appeared in *Nature*, in which the effect was spoken of as an alleged effect, and that there was no evidence of a true change in the carbon, as I had said there was. This was followed by an article by Prof. Sylvanus Thompson, in which he quotes Professors Barrett and Tomlinson as agreeing with him that there was no true change of resistance in carbon under pressure.

A short time ago I attacked the problem again. I undertook to settle it, not with reference to the time effect nor with reference to a quantitative change of the resistance, but solely to determine whether there was a real change in the resistance of carbon under pressure. I began with hard carbon because it is easier to make a crucial test. The method consisted in passing a current through a rod of hard carbon. I used various rods, one of which was an electric light carbon. The copper was removed with the exception of a centimeter in width at each end. Corks were inserted over the ends of the tubes, the inside of these corks being hollowed out clear around and mercury poured in so as to make as perfect a communication as possible. There were unquestionable and invariable results showing a diminution of the resistance of carbon by pressure. It was small but invariable. There was not a single swing of the galvanometer in the opposite direction.

I was aware that this experiment was not a new investigation. Prof. Tomlinson presented in January, 1882, a paper to the Royal Society on the influence of stress and strains on physical forces, in which he proved a change in resistance of carbon under pressure. Prof. Thompson seems to be unaware that the person he quotes as opposed to this view had previously established the fact.

I compressed the rod laterally, so that there could be no possible modification of the contacts by the application of the pressure.

I then experimented with soft carbon, although being true for hard carbon it would follow naturally that it was true for soft carbon. I had a couple of tubes with the ends ground obliquely, so that when they were brought together it made a V-shaped tube. The attaching of the carbon button inside one of these tubes was a matter of considerable delicacy, as the buttons are very frail, but I succeeded in getting several attached by means of mucilage. A little mercury was poured in each tube, so that the whole surface of the button was covered. The mercury in each tube was kept at the same height.

I used first a tube of this shape ⊔, but I settled on the V shape, because, owing to the form, the air would go out and leave a good mercurial contact.

I did not determine the absolute resistance, but there were very large changes. For instance, when there was a pressure of 3 mm. of mercury, I had a resistance of 230 divisions of scale (using a high-resistance galvanometer), and for 60 mm. of mercury the resistance fell to 96 divisions.

The experiment is not completely satisfactory, because we are sending our current and measuring our resistance through the same surfaces through which the pressure is transmitted.

I was very anxious to ascertain what had been done by Prof. Barrett, as it was stated that he had tried this same experiment, with mercury electrodes, and had obtained no effect. Prof. Barrett has communicated to me a detailed account of his experiments, and I may be pardoned for sketching them as he has acknowledged they were faulty. A U-shaped tube was used with the button fastened inside, a short distance from the end. Mercury was then poured in the tubes, care being taken to exclude the air so as to get perfect contact. The pressure was brought about by one column only. In this experiment, he was not pressing his carbon button, but only one side of it, the mercury on the other side remaining constant.

A Member: All these experiments have come from the application of carbon to the transmitting telephone, and in the hope of finding some explanation of its behavior when so used. It occurred to me some time ago to put into a

*Abstracts of papers and discussions.

circuit with the transmitting telephone a galvanometer, and so observe, if I could, the difference in resistance when being used as a transmitter and when not, supposing I should find the resistance greater when used as a transmitter. All my observations, however, tended to show that the resistance was less when used as a transmitter than it was when it was standing idle.

5. A Spectrophotometric Study of Pigments. By E. L. Nicolls.

The author took exception to the customary use of the three so-called constants of colors, viz., purity, hue and lumino-ity, in studying the colors of pigments. His method is to compare under the spectroscope each wave leng'h of the pigment spectra with the corresponding wave length of white daylight. The intensity of the pigment color is thus determined as a function of the wave length. A curve is thus determined with the intensity as ordinate and the wave length as abscissa, which sufficiently characterizes the pigment. Perhaps the most direct application of the method would be the study of the absorption of spectra. By taking solutions of different degrees of saturation, we can obtain the relation between the strength of the solution and the curve of its spectra. A perfectly pure color will be represented on this chart by a straight line, and its luminosity by the length. The area included by the curve represents the total amount of energy which the pigment reflects, as compared with the amount of energy reflected by white.

Prof. Rowland: The question of the absorption of color is an interesting one, and I am glad to see it taken up. It is a wonderful fact in nature that you have many reds and yellows, and colors in the lower part of the spectra, but you do not have many blues and violets. It comes out, I believe, under the electro-magnetic theory of light, that the short waves are absorbed quicker than the long ones. I do not think there is any substance that cuts off the long waves and lets the short waves go through. Of course the color of pigment is due to a transmission of light through a small portion of the pigment and not to surface reflection as in the case of metals, and this law would apply, therefore, to the colors of pigments.

CANTON TO TONQUIN.—The state of affairs in the far East renders it necessary to increase telegraphic facilities there. The new line from Canton to Tonquin is progressing rapidly.

THE TELEGRAPH.

THE UNITED TELEGRAPH LINES.—As we expected and predicted last week, the combination between the three "opposition" telegraph companies has been broken up, owing to the inability of the crippled Bankers & Merchants' Company to fulfill its part of the contract. The B. & O. and the Postal companies will probably be stronger without their late associate.

DEATH OF MR. PARTRICK.—We regret to announce the sudden death, on Sunday last, of Mr. James Partrick, senior member of the firm of Partrick & Carter, the well-known Philadelphia manufacturers of electrical supplies. His death was caused by gastric fever, and has been a matter of great surprise to his numerous friends and acquaintances, as he was in the prime of life. Years ago he was a prominent operator, being at one time Western Union chief operator. It was in 1866, we believe, that he went into business for himself. He was successful from the start, and, in addition to his electrical business, had considerable shipping interests. But recently he made a trip around the West Indies in one of his vessels. Mr. Partrick at all times took a warm interest in matters that related to the welfare of operators and the advancement of electricity, and he will be greatly missed from the circles that have known him.

THE TELEPHONE.

THE DRAWBAUGH CASE.—It is stated that arguments in the Bell-Drawbaugh telephone case will be heard in New York city on Sept. 22, instead of at Syracuse, N. Y., on Sept. 15.

THE ELECTRIC LIGHT.

DIVIDEND.—The New Bedford, Mass., Electric Light Company has declared a dividend of 3 per cent.

MISCELLANEOUS NOTES.

AN INVENTORS' EXHIBITION.—The exhibition to be held at South Kensington next year will be devoted to leading departments of invention. Electrical machinery and apparatus is to be classified as follows: Class 66. Generators.—Dynamos, primary and secondary batteries, thermo-electric batteries. Class 67. Conductors.—Submarine cables and apparatus for laying them, aerial wires and underground cables, insulators and poles, insulating and coating materials, joints and connections, underground conduits, pipes, tubes, troughs, etc., electric light leads. Class 68. Testing and measuring apparatus.—Galvanometers, magnetometers, dynamometers, voltmeters, current-meters, methods of testing. Class 69. Telegraphic and telephonic apparatus.—Needle instruments, A B C instruments, Morse instruments, type-printers, relays, duplex and quadruplex apparatus, keys, recording instruments, automatic transmitters, electric bells, indicators, telephones, microphones, lightning protectors. Class 70. Electric lighting apparatus.—Lamps, resistance coils, cut-outs, safety catches, switches, fittings for glow and other lamps. Class 71. Electro-metallurgy and electro-chemistry.—Methods of depositing and coating various metals, electrotyping, galvano-plasty, vats, cleaning and polishing apparatus, materials, tools and appliances. Class 72. Distribution and utilization of power.—Electric railways, electric motors, electrically driven boats, tricycles and other conveyances, systems of distribution. Class 73. Electric signaling.—Fire and burglar alarms, railway, ship and time signals, water level and wind indicators, tell-tales, electric clocks, chronoscopes, etc. Class 74. Lightning conductors. Class 75. Electro-medical apparatus. Class 76. Electrolytic methods for extracting and purifying metals.—Copper, zinc, lead, iron, refining the precious metals. Class 77. Electro-thermic apparatus.—Electrical apparatus for war, mining, blasting and other purposes.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, the Boston Exchange and elsewhere are as follows:

TELEGRAPH.—Am. Cable, b 55, a 56½; B. & M., b 5, a 10; Mutual Union, b 12¼, a 14½; Postal Stock, b 3½ a 4; Postal sixes, a 40; Western Union, b 66⅛, a 66¼.

The Western Union Company will pay its regular dividend of 1¾ per cent.

TELEPHONE.—American Bell, b 154; Erie, b 20; Mexican, a 1¾; New England, a 25⅛; Tropical, a 1½.

The Boston *Herald* of Sept. 10 says: "The sharp rise in Erie telephone shares to 20 was the most notable event to-day. The internal dissensions have ceased, and peace is added to whatever prosperity the company is enjoying. Less than 50 shares sent the price up 4 points, or 25 per cent. in this instance. Later there was a reaction to 18½. New England improved fractionally by sales at 25⅛."

ELECTRIC LIGHT.—Edison, b 75, a 100.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

Edited by N. S. KEITH, Electrical Engineer and Expert, 9 Murray Street, New York.

PATENTS DATED AUG. 26, 1884.

Device for Protecting Electric Light Systems from Lightning; T. A. Edison, Menlo Park, N. J... 304,084

The combination, with an electrical generator and the external circuit therefrom, of two conductors extending from each side of said circuit to the earth, and means controlled by the current in one of the earth-circuits thus formed for controlling the other earth-circuit.

Dynamo-Electric Machine; F. J. Sprague, U. S. Navy..... 304,145

The winding is a modification of the Hefner-Alteneck system.

Dynamo-Electric Machine; T. A. Edison, Menlo Park, N. J..... 304,083

The field-magnets are so connected that any arm may be removed without disturbing the others. A fine wire screen is placed over the armature between the poles of the field-magnet, to stop particles from falling into the armature space.

Electric-Battery Jar and Method of Insulating the same; I. D. Fuller, Atlanta, Ga..... 304,265

The jar is enveloped in a suitable insulating material placed between the battery-jar proper and an external containing jar. The whole may be made as one piece.

Electric Conductor; F. D. Cady, Waterbury Conn.. 304,170

Composed of strips of metal arranged in parallel lines, and bound together and insulated from each other by non-conducting material which is wound between and around the strips.

Electrical Conductor; T. A. Edison, Menlo Park, N. J..... 304,087

Guard-wires are stretched parallel with the conducting wires, but above them. These guard-wires serve to catch other and crossing wires when they fall, thus preventing the loose wires from coming into contact with the lines which they cross.

Electrical Meter; T. A. Edison, of Menlo Park, N. J..... 304,082

An electrical meter having in combination two electro-depositing cells and means for passing current through the cells alternately.

Electrical Signaling Apparatus; J. N. Mackenzie, of New York..... 304,209

The object is to provide such an apparatus as will be simple, compact, and durable in construction and reliable in operation.

Incandescent Electric Lamp; T. A. Edison, Menlo Park, N. J..... 304,086

The lamp base or plug is provided with a spring tending to force the two plates apart, and through which the electrical connection is maintained.

Magneto-Electric Signaling Attachment for Telephones; A. J. W. Munch, of Berlin, Germany.. 304,121

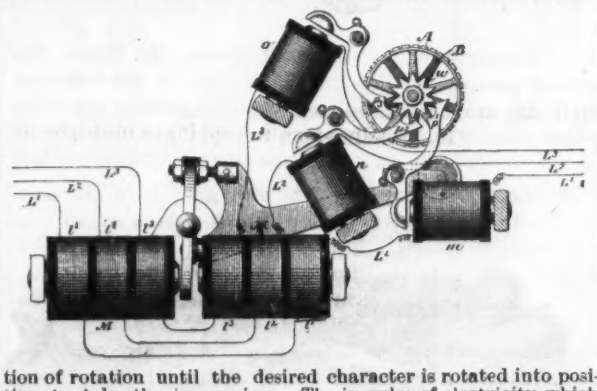
The invention consists of a telephone of that class having a horseshoe magnet, an armature arranged intermediately between the pole ends of the magnet, and means whereby the same is rotated so as to generate induction-currents in the induction-coils of the magnet which actuate either the diaphragm or the diaphragm and a vibrating sounding device arranged in contact therewith.

Means for Overcoming Static Troubles in Telegraphs; F. W. Jones, of New York..... 304,106

An improvement upon U. S. patent No. 260,208, of June 27, 1882.

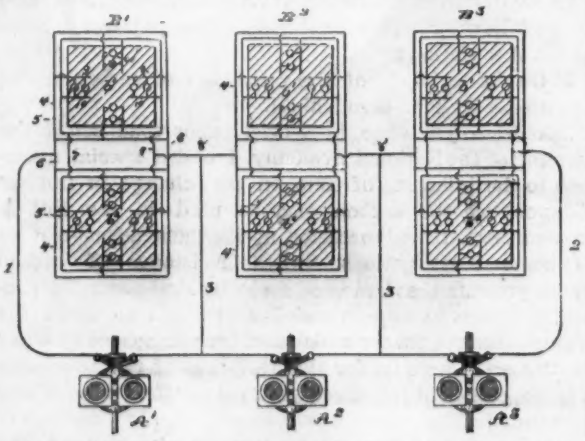
Means for Rotating the Type-Wheels of Printing-Telegraphs; George M. Phelps, of Brooklyn, N. Y..... 304,025

An impulse of electricity to be first sent through line L' and magnet m. Pawl p' is operated, and impinging upon the tooth of the star-wheel immediately before it moves that wheel, and with it the shaft and type wheels, one step. This movement is sufficient to present a tooth of the star-wheel immediately before pawl p''. Following in rapid succession the impulse over L', an impulse is sent over L^2, whereby magnet n is energized and pawl p'' operated. These steps are successively repeated in the operation of rotation until the desired character is rotated into position to take the impression. The impulse of electricity which effects the last step of rotation is prolonged, thus retaining the pawl in engagement with the star-wheel, by which means the type-wheel is firmly held. The polarity of the impulse thus prolonged is then reversed and printing effected.



System of Electrical Distribution; T. A. Edison, Menlo Park, N. J..... 304,085

The figure represents the principle applied to the lighting of a district in a city or town. A three-part system is shown, there being three dynamo or magneto-electric machines, A', A^2, and A^3, and main and compensating conductors 1 2 3, leading therefrom. These machines will be located together at a central station. The district to be lighted (represented by six blocks) is divided into three divisions, B' B^2 B^3, each division being composed of two blocks, b' b^2. A positive conductor 4 is run entirely around each block, completely encircling the same, the ends of the conductor being joined to make an endless conductor. A negative conductor 5 is run in a like manner around each block. For each division the conductors of like kind of the two or more blocks composing the division are connected together by conductors 6 7. Connections 6 7 are made between the conductors of blocks b' b^2, at opposite extremes of each division of the circuit. Intermediate connection may also be made. Positive main conductor 1 is connected with the nearest central cross-connection 6, of the positive main conductor 4 of division B'. From the most distant central cross-connection 7 of the negative conductors 5 of division B' runs a conductor 8 to the nearest positive central cross-connection 6, of B^2. Divisions B^2 and B^3 are connected in a like manner by another conductor 8, while with the negative side of B^3 is connected the negative main conductor 2 from the central station. The compensating-conductors 3 run to the division-connecting conductors 8. House-circuits 9 10 extend from the main conductors 4 5 and in them are arranged in multiple arc the lamps or other translating devices, a. These translating devices are all equidistant from the source of electrical energy, the arrangement of endless conductors and central connections producing a true lapping of the conductors.



Printing-Telegraph; W. B. Van Size and Chas. L. Buckingham, of New York..... 304,052

Uses two main lines, which extend from the transmitting-station to one or more receiving-stations, the two main lines respectively embracing two multiple-arc coils wound in the same direction upon the core of the escapement electro-magnet, and each of the main lines embraces the coils of an independent press-magnet. The motive power for taking an impression is furnished by any suitable motor, having a constant tendency to start into action, but which is held in check by the projecting end of the bar, upon the opposite end of which the press-pad is located.

Telegraphic Transmitter; R. Anderson, Peekskill, N. Y..... 304,059

The circuit wheel is rotated always in one direction.

Telephone Switch-Board; P. G. Rousseau, of Detroit, Mich..... 304,135

Consists in the construction, combinations, and operation of the parts.

Transmitter for Printing-Telegraphs; G. B. Scott, Brooklyn, N. Y..... 304,037

Consists, first, of means for directing upon the main line short and rapid reversals of electricity to rotate the type-wheel; and, second, means for stopping the type-wheel at any desired character and means for prolonging an impulse for the taking of an impression from the type-wheel. For the purpose of directing short and rapid reversals upon the line, there is provided a circuit-wheel, the periphery of which is composed of an equal number of conducting and insulating spaces, the total number being equal to the number of characters upon the type-wheel.

Unison Apparatus for Printing-Telegraphs; W. B. Van Size, of Brooklyn..... 304,051

Comprises a type-wheel mounted upon a motor-driven shaft having a step-by-step rotary movement controlled by a polarized electric magnetic escapement. Firmly fixed to the type-wheel shaft is a radial arm moving in the plane of an armature-bar, which bar is controlled by a neutral electro-magnet located in the same main line with the escapement-magnet.

Unison Apparatus for Printing-Telegraphs; A. A. Knudson, of Brooklyn, N. Y..... 304,007

Consists in the employment of a radial rotating arm rigidly fixed upon a type-wheel shaft, and an armature-lever which, under varying current conditions of the main line, is adapted to rest in the path of the rotating unison-arm or be removed therefrom. The unison armature-lever is controlled by electro-magnetism derived from the main-line circuit, and a retracting spring.